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LITTLE WORD—BIG PLANS

ONE little three-lettered word spells the whole theme of the November *Chem. & Met.* That word, we think, will be in the minds and on the tongues of more than 35,000 chemists, engineers and industrialists who are expecting to attend the Fifteenth Exposition of Chemical Industries at Grand Central Palace in New York, during the week of December 2. They are coming in search of something *NEW!* They want to see and learn of "What's New?" in products, processes and equipment. With Old Man Depression on the way out at last, these men will want to break away from the old penny-pinching practices that have hampered and handicapped their progress. They have their hearts set now on new and better methods and machinery.

SO that's why your editors are building the entire November issue around that one little adjective *NEW*. Both subject matter and typography will reflect its influence. A beautifully illustrated article descriptive of the company winning the second biennial Award for Chemical Engineering Achievement will appear as a special editorial feature, reproduced by a unique process of printing that has never been used previously in any American technical journal. New chemical engineering processes developed during the past few years will be presented in short, almost telegraphic-style articles, each accompanied by data and flowsheets comparable in size and scope with those in the famous 1934 series. New products will be catalogued and classified in comprehensive useful tabulations.

BUT the single most important purpose of *Chem. & Met.'s* Exposition Number will be to bring chemical engineers up-to-date on new developments in the field of equipment. So this year we're reversing the usual procedure of reporting developments *after* the Show and will include a Preview in text and picture of "What's New to Be Seen at the Chemical Exposition." And, by way of setting, we will attempt another systematic review of recent trends in unit operation equipment, design and construction.

OTHER features on new plants, new types of chemical containers, new problems for management, and new . . . . . but why go farther? Let's boil it down to the simple statement: We are going to build a big issue around that little word—NEW!

S. D. KIRKPATRICK
Editor

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Market Editor

THEODORE R. OLIVE
Associate Editor

R. S. McBRIDE
Washington

PAUL D. V. MANNING
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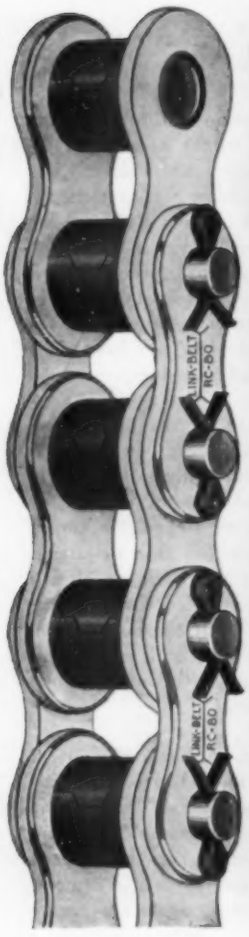

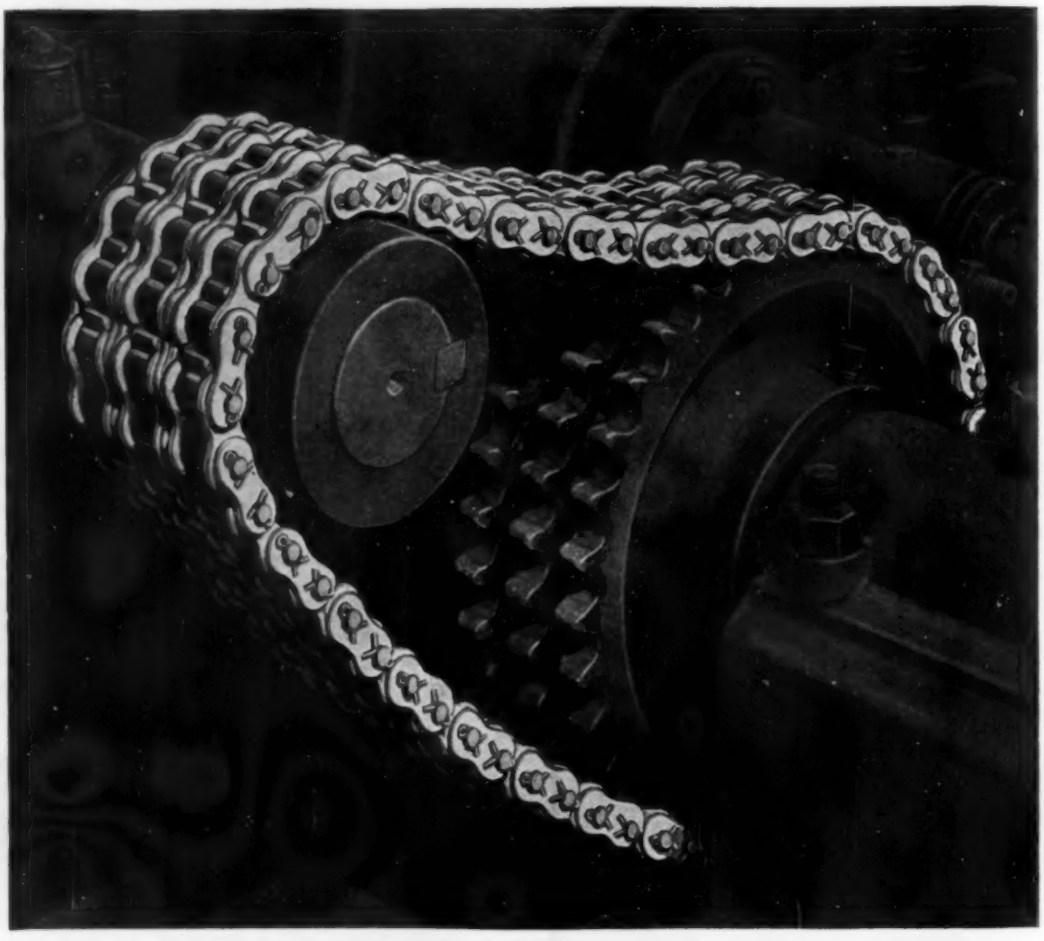

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S. D. KIRKPATRICK, Editor

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WHAT ARE THE MUNITIONS OF WAR?

CHEMICAL INDUSTRY has much more than casual interest in the work of the National Munitions Control Board, which has been set up in the State Department under the neutrality act. Chemical activities are certain to come under its closest scrutiny if not actual control as far as exports are concerned. The fact that certain branches of chemical industry have a close inter-relation in their peace- and war-time activities makes this interest obligatory on the part of the board. It also makes it just as essential that all chemical executives should approach the problems of neutrality with the broadest concept of public duty and responsibility.

No right-thinking American disagrees with the purpose underlying the neutrality program, namely, that no trade activity of the United States or its citizens shall draw this country into a position of unfriendliness, much less the actual violation of neutrality. The problem, as is so often the case with regulatory legislation, lies in the interpretation and administration of the program. As long as the prohibition of exports to belligerents is limited, as first announced, to such direct materials of chemical warfare as mustard gas, lewisite, and ethyl- and methyl-dichlorarsines, there can be no cause for dispute, nor even for inconvenience to the chemical manufacturer. But those who make other materials less directly related to war-time activity must recognize the fact that this list was only a first effort. Amplification and extension into other fields is to be expected. Wise policy would seem to dictate, therefore, that plans and contracts for foreign shipments be made with a view to possible interruption by new presidential embargoes.

Experience with the War Industries and Trade Boards during the World War taught us that the control of raw materials was the real crux of the munitions problem. Nitrates, sulphur, cotton, rubber, petroleum, scrap iron and steel, tin, copper, lead, zinc, phosphate rock, chromite, manganese—these, with food and clothing, are the prime essentials of modern warfare. If the Italian-Ethiopian conflict spreads to Europe, a raw material embargo becomes the most effective measure of control. And since chemical industry is dependent on these same raw materials, it is evident that any such interference with foreign trade would bring direct repercussions in this country.

Judging by the rise that has occurred recently in the prices of certain commodities and securities, there are many who believe that chemical industry stands to gain in the event of a spread of war to Europe. In a very limited sense this may be true, but it is also true that other branches of the industry would be adversely affected. By and large, American chemical industry has more to gain from a general business revival here than from any trade with warring nations. This makes it all the more important, therefore, that our definition of what constitutes munitions should be most carefully drawn, only after intelligent study of the effects on domestic industry as well as on the neutrality program. The Munitions Board may have in its hands what will amount to life-or-death control over vitally essential chemical industries. Let us hope that it continues to administer the neutrality program wisely and sympathetically.

From an EDITORIAL Viewpoint

DuPont Wins Achievement Award!

FOR its meritorious achievement in the successful large-scale production of synthetic rubber, synthetic camphor and a variety of other essential organic chemicals and dyestuffs, E. I. duPont de Nemours & Co. is to receive the 1935 Award for Chemical Engineering Achievement. The Committee of Award, comprising eight representative leaders of the industry and profession, has held this to be the outstanding example of group effort and attainment on the part of American chemical engineers during the past two years.

Back of these specific developments, of course, lies the major achievement of the duPont company during the past two decades in building a diversified dyestuffs and organic chemical industry in the United States. The important part played by the chemical engineer in that program will be described in an unusual article in this magazine in November. Presentation of the award will be made by *Chemical & Metallurgical Engineering* at the close of the Fifteenth National Exposition of the Chemical Industries in December.

May we on behalf of the industry and profession also extend your congratulations on this worthwhile achievement?

Dare We Say "Biggest and Best?"

WERE YOU ONE of the 34,269 registered visitors who attended the Fourteenth Exposition of the Chemical Industries in New York in 1933? If you were, you may still have memories of that encouraging spectacle of what chemical engineering had accomplished in those depressing times when many older industries had folded up their tents and run for cover. Now that the economic clouds are clearing and the worst part of the storm seems to be over, it's going to be interesting to see how much farther these industries have come as a result of these last two years of steady advance. Perhaps it isn't fair for us to prophecy, for we have had a chance to look behind the curtains, at least to the extent of a glimpse of some of the new equipment to be shown for the first time in December. But we will hazard a guess that this will be the biggest chemical show in the last ten years and one long to be remembered.

It is in keeping with the times. Out in Cleveland last month, the Machine Tool Show is said to have heralded the re-birth of the heavy industries of the country. It attracted attention and comment of many interests entirely outside of the metal-working field. If these "machines to make machines" were in such demand, it is not difficult to foresee a capital goods revival of generous proportions. Reports from the Seventeenth National Metal Exposition in Chicago reflected the same optimistic confidence—and this same desire to forge ahead with new products and processes.

So, we repeat, the stage is set for chemical engineering's biggest and best chance to show its wares to a large and eager audience, intent on maintaining chemical industries' leading rôle in the recovery.

Investment in Engineering Futures

FOR SO MANY YEARS *Chemical Abstracts* has done such a remarkably comprehensive and competent job in the field of chemistry that chemical engineers often have reason to regret that there is no comparable place to turn for engineering abstracts. The agency that has come the nearest to serving this need is the *Engineering Index*, which for 50 years has been the principal annotator of current engineering literature. Five or six years ago in cooperation with a Committee of the American Institute of Chemical Engineers, the *Engineering Index* made an encouraging start on a program for abstracting the growing literature of the unit operations and processes, supplying this information to industry under several series of card references. But as the depression came on, the *Index* found itself without the support of its principal sponsor, American Society of Mechanical Engineers, and its whole future was seriously threatened. Fortunately, we believe, a plan has been developed to save and make this necessary tool much more valuable.

A group of farseeing engineers, educators and industrialists, headed by Dean Collins P. Bliss of New York University, Dr. Frank B. Jewett of the Bell Telephone Laboratories and John Van Nostrand Dorr of the Dorr Co., has undertaken to raise a working capital to see the *Engineering Index* through a five-year period under a plan that will make it self-sustaining at the end of that time. They have directed their appeal to American industries which benefit directly or indirectly through the application of any branch of engineering. To date a number of corporations have responded with contributions ranging from a few hundred dollars to ten thousand, spread out over the five-year period. But more funds are needed.

Chemical executives whose companies responded so generously a few years ago when it was necessary to underwrite *Chemical Abstracts* in order to tide it over a similar emergency may well give thought to a similar investment in the future of *Engineering Index*. Both services are necessary if chemical engineering is to advance rapidly and efficiently.

Automatic Equipment Extends Solvent Uses

TWO IMPORTANT MORALS may be drawn from the staff article in this issue which describes a splendid example of applying automatic equipment to solvent recovery by activated carbon. First, there is the economic aspect of the case. Relatively high-priced solvents affect the cost of products on which they are used only to the extent of the actual ultimate consumption. Where from 60 to 90 per cent of the solvent entering a process can be recovered economically and returned to use, the net cost of the solvent is much less than would appear from mere appraisal of quantities applied and the market price. With growing complexity of chemical processing, this widening of the area in which relatively high-cost solvents can be applied is an important advantage to the chemical engineer.

A like economic advantage in cases such as the one described comes from the possibility of putting a complicated technical operation into the hands of plant operatives, even though they may not be skilled chemists —perhaps even when they are only "practical" workers. The installation at Johnson City is one of the best examples of this possibility which has recently come to our attention. The refinement of control equipment and the precision of processing which have been built into the plant combine for an almost complete elimination of technical supervision. There is, to be sure, a skilled and competent chemical man elsewhere in the works; but fortunately he finds that the demands on his time and skill in this solvent recovery unit are almost negligible. Good instrumentation and modern chemical engineering have combined to achieve a result that is a credit to both.

Silicosis— Industrial Hazard

WITH THE ADVENT of the safety season, the outward manifestation of which is the meeting at Louisville of the National Safety Council, it behooves process industries to give thought to the constantly growing importance of silicosis as an industrial hazard. The problem is one of vital interest not alone from the humanitarian standpoint but because of its dollars and cents implications, as well. In an increasing number of states silicosis is coming to be regarded as a compensable industrial disease, comparable with accidents. In still other states suits at common law for the compensation of alleged injuries due to silicosis have increased in number and vigor to the point where the word "racket" is becoming accurately descriptive.

In many process industries the nature of the work is such as to produce dusts. Even with innocuous dusts it is good policy to give workers adequate protection from personal exposure, in the interests of improved morale and employment standards. But when the dust contains silica or silicates, particularly the fibrous aluminum silicates which appear to have been proved on a par with silica, the hazard may equal that with other industrial poisons, more quickly fatal but no less insidious.

Although many phases of the silicosis problem have not by any means been settled, there are, fortunately, well established methods for supervising and improving plant conditions. Reasonably accurate dust counts can be made and the character of dusts can readily be determined in the laboratory. Employee examination, both for predisposition to silicosis and for the presence of the disease, has a well-established medical technique as the result of much recent work along these lines. Methods for dust elimination have been put upon a practicable basis for most of the dust-producing industries. Management needs, therefore, only to apply diligence in the use of present knowledge and equipment to avoid serious future consequences.

Selenium Report Sets New Standard

RESEARCH of far-reaching consequence, done in an admirable spirit and with the cooperation of a large group of investigators of diversified interest, has produced something of a classic document from the Bureau of Chemistry and Soils. We refer to the technical bulletin entitled "Selenium Occurrence in Certain Soils in the United States," by Horace G. Byers. That document portrays in a clean-cut fashion and without pulling its punches the serious character of the problem created by selenium in causing the so-called alkali disease in cattle. It does not hesitate to recommend drastic measures, even to the extent of condemnation of certain territory in which grazing should be forbidden.

But more striking than the vigorous findings is the elaborate organization which worked under the able direction of Director H. G. Knight of the Bureau, to bring every available type of worker into an effective team. The results are, therefore, unusually convincing from the standpoint of the chemist and engineer, as well as from biological, botanical, and agricultural points of view. Furthermore, an issue which might have resulted in panic, had it been carelessly handled, now comes out in a matter-of-fact form that is convincing without being alarming.

Action must be taken to remove these dangerous soils from production and to prevent grazing on territory where the vegetation causes alkali disease or the more acute form of blind staggers. Rightly, however, the bulletin says, "but the emergency is not serious enough to warrant hasty measures."

All industrial executives will wish that other divisions of the Department of Agriculture could proceed in as sound and orderly a fashion when they find problems needing study and situations needing correction.

Fig. 1—Part of the Endicott-Johnson plant with the solvent-recovery building at the right

Automatic Controls Operate a SOLVENT RECOVERY PLANT

By R. S. McBRIDE

Editorial Representative, Chem. & Met.

SOLVENT recovery at high efficiency and minimum cost is the result of fully automatic process operation and control in a recent installation at the plant of Endicott-Johnson Corp., Johnson City, N. Y. This novel installation was designed and installed by the Activated Carbon Division of Carbide & Carbon Chemicals Corp., utilizing automatic equipment never before applied anywhere in the world to a task of this type. The solvents so recovered are acetone and hexane; and the automatically controlled recovery equipment functions so efficiently that the process of recovery is substantially complete, with over 98 per cent finally reclaimed in a refined form ready for reuse.

The distinctive feature of this plant is its completely automatic operation and control. The attendant starts up the apparatus at the beginning of the day and turns it off at the end of the shift in the evening. During the operating period, so far as recovery equipment is concerned, no attendance is required. The only operator working in the building is engaged solely in supervision of the continuous refining column by which the recovered acetone is purified. Even the duties involved in this refining operation are nominal, largely of a precautionary, routine, record-taking type.

This installation for solvent recovery is used for the first time in the shoe industry as an incident to the manufacture of box toes. The general process consists of impregnation of a felted fabric with a base mixture of Vinylite, rosin, and small quantities of other constituents by the simple process of wetting and drying. The fabric is received in large rolls. It is passed through an impregnating tank in which the mixed resinous materials are held in solution by a hexane-acetone solvent mixture. The wet impregnated fabric is then passed through a long horizontal dryer where the solvent is vaporized and removed by a stream of heated air.

Safety in operation requires that the concentration of solvent vapor in the air always be maintained below the range of explosive or flammable limits. This condition is insured, for the maximum rate of impregnation practiced, by exhausting a sufficient volume of air from the dryer to maintain a solvent vapor concentration of approximately 0.4 per cent by volume in the atmosphere leaving the fabric dryer. This is well below the lower limit of flammability for the solvents used.

The air as it leaves the dryer is at approximately 140 deg. F. It carries suspended particles of plastic mixture and a fine rosin dust. The larger resinous particles are removed in a specially designed collector. The finer dust is then completely eliminated in a standard type filter unit. The resin collector and filter are housed together in a single sheet metal chamber which is installed in the duct between the dryer and the intake of a blower which passes the vapor-laden air through the adsorber system. From the blower the air passes through a cooler with fin-type tubes, cooled by water that is auto-

matically controlled to keep the vapor-laden air at a temperature such that it will not be over 100 deg. F. when it comes in contact with the activated carbon used as the adsorbent.

The two adsorption chambers shown in Fig. 3 are horizontal cylindrical tanks of special internal design. Each adsorber has a vapor-laden air inlet near the top through one end and a similar clean-air outlet near the bottom through the other end. The vapor-laden air passes through an air diffuser downward through the activated carbon bed supported horizontally. All metal parts in contact with the carbon are of a suitable corrosion resistant alloy.

The operating cycle is very simple. Vapor-laden air is introduced into adsorber A for a predetermined period and is then automatically diverted into adsorber B for a like period. When adsorber A is cut out of service the air contained in it is displaced by steam passed around the carbon bed and is vented back into the vapor-laden air duct. The adsorbed solvent is then removed from the carbon by steam which passes upward through the bed for a suitable period, carrying out the acetone and hexane vapors to the condensing and refining equipment. The steamed carbon in adsorber A is then either immediately put back in service or air discharged from adsorber B is forced through it by a second blower until the carbon is partially cooled and dried. The two blowers in this plant are installed so that either may pass vapor-laden air to the adsorbers. This arrangement makes the cooling blower in effect a spare blower and insures continued operation of the recovery plant even if one blower fails to function.

If there should be traces of solvent escaping from adsorber B toward the end of the adsorption period, this trace would be adsorbed in adsorber A during the last of the cooling-down period. As a matter of fact, however, this precaution of running the adsorbers in series is not commonly necessary for complete recovery of solvent vapor. It does, however, add a feature of advantage that contributes to the completeness of recovery, especially of low-boiling solvents.

Automatic functioning of the 14 air, vapor and steam valves and the two blowers required for the complete system has been provided. A time mechanism insures accurate succession of operations at intervals predetermined to be optimum for smooth performance. Therefore, so long as there is electric power, air and steam on the lines to the recovery building the parts of the apparatus will function in rotation and without any attendance.

When it approaches time to shut down, the operator turns the main control to the stop position, but the apparatus does not immediately cease functioning. Except in emergency it can stop only at times in the cycle so selected as to leave the apparatus in a safe and satisfactory standby condition ready to be started up next day. If the precaution had not been taken of installing this delayed control the carbon might be left hot and wet, mixtures of solvent vapor and air might remain in some parts of the system, or other disadvantageous conditions might prevail.

The apparatus is equipped wherever necessary with automatic-control devices. A mere listing of these shows the completeness with which accuracy of operation is maintained without manual control. The major controlled functions which deserve mention are the following:

1. Constant air flow is obtained by means of a controlling air flowmeter which actuates variable pitch vanes in the intake of the blower.

2. Constant temperature of the vapor-laden air entering the adsorbers is maintained by automatic control of water flow through the cooler tubes.

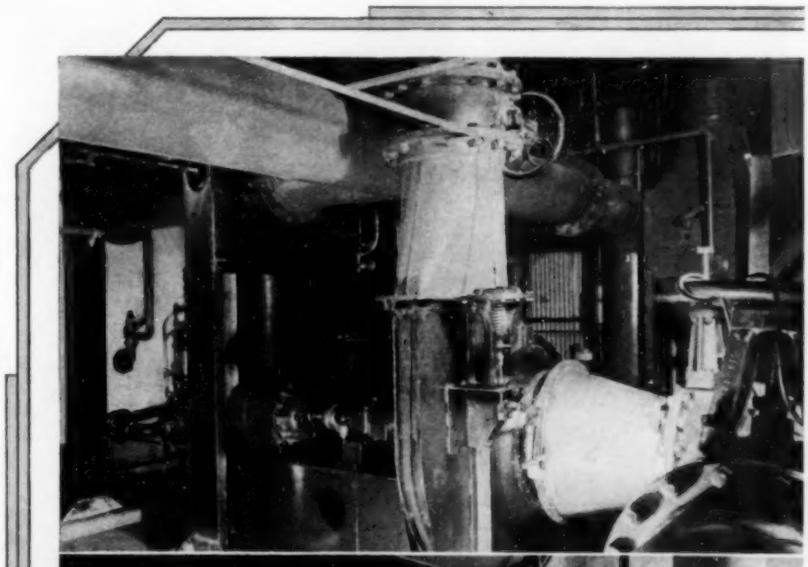


Fig. 2—Adsorbing blower showing automatic vane control diaphragm; at the right, fin-tube cooler and at the left, end of one adsorber

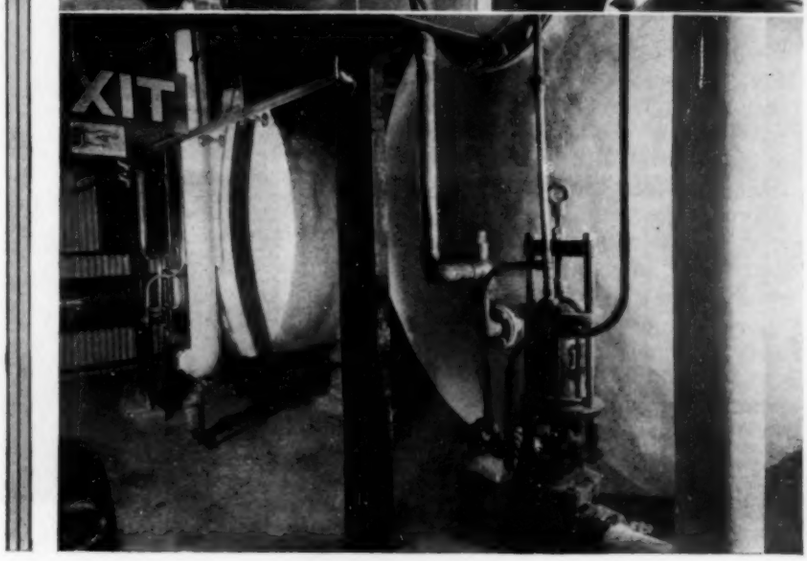


Fig. 3—Inlet end of the adsorbers showing hydraulically operated valves on steam lines

3. Control of the quantity of steam entering the adsorbers is obtained by a flowmeter which actuates a diaphragm-top throttling valve.

4. Control of the steam pressure in the adsorbers is obtained by means of a pressure regulator mechanism.

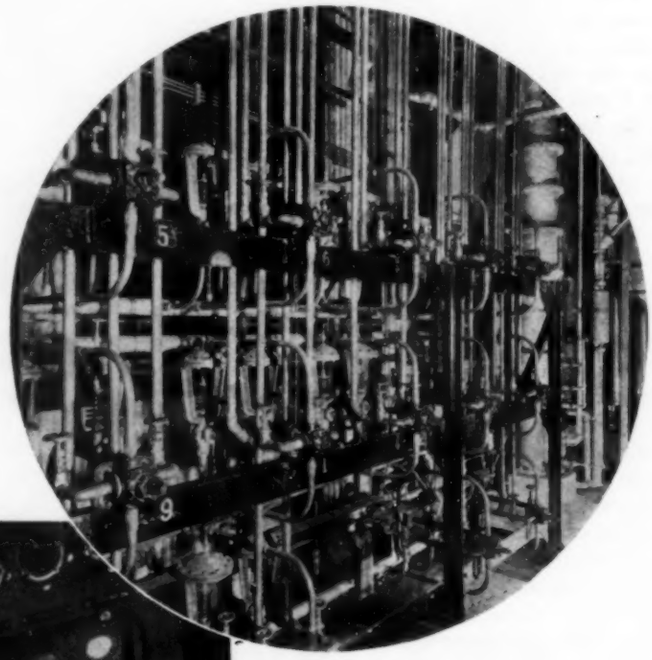
5. Constant temperature of the condensate leaving the combination adsorber condenser and cooler is maintained by automatic control of water flow through the tubes.

6. Constant water pressure for hydraulic valve operation is maintained at approximately 100 lb. by automatic operation of a pump.

7. Safety of the recovery operation is insured by automatic shutting down of the fabric impregnating machine and the source of solvent vapors if the flow of vapor-laden air to the recovery apparatus is stopped or reduced below a completely safe limit. A mercoid switch actuated by the air flowmeter cuts off the power to the motors which drive the impregnating machine. Thus, if the solvent recovery mechanism cannot function safely, the felt impregnation must stop. The operator must, therefore, correct air-flow conditions to normal before workers on the impregnator can again start up their equipment and carry out their part of the operation.

8. Safety in the plant is further assured by automatic pressure-relief mechanisms provided at every point at which pressure otherwise might possibly build up beyond the safe limits of the apparatus. All these vent to the outer air at high levels where sudden emergency discharge cannot endanger workers or others.

One of the factors responsible for the success of the automatic operation of the plant was the selection by the designers of a type of valve which would operate quickly and smoothly without sticking and which would stay



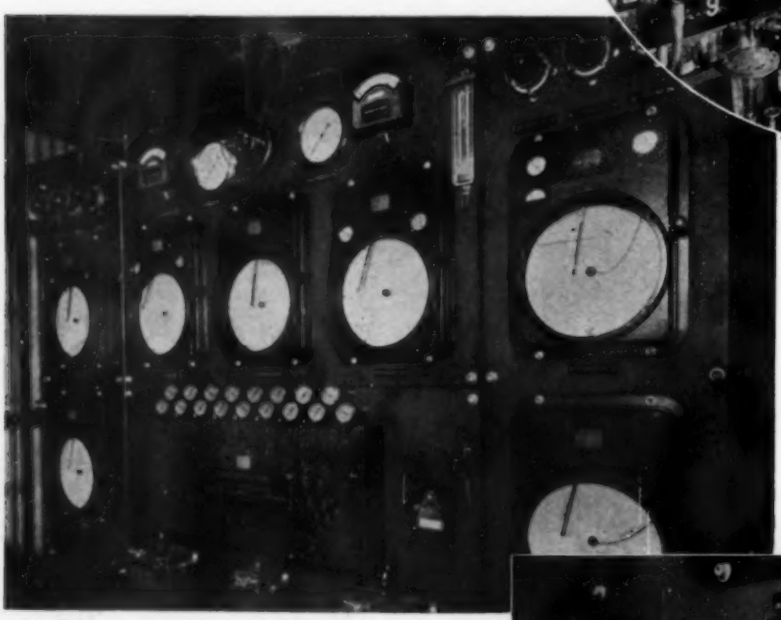
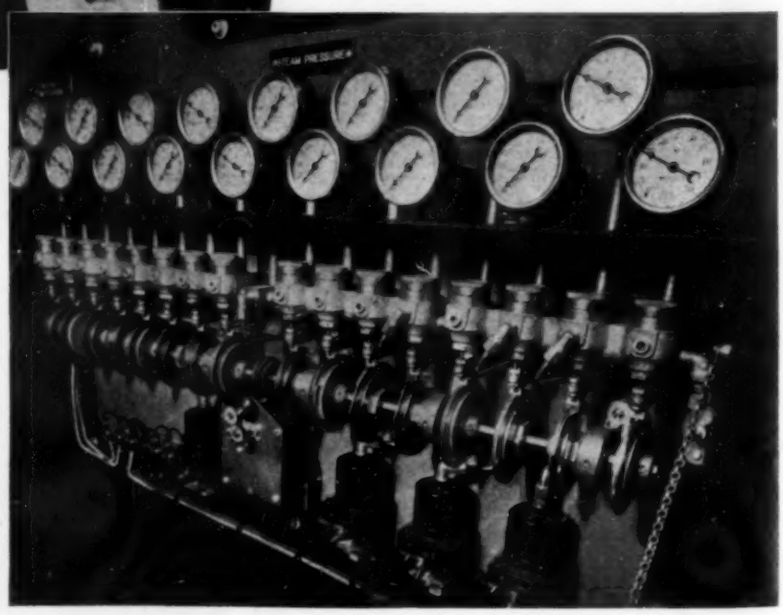


Fig. 4, Left—Plant control panel showing controlling, indicating and recording instruments, with cycle controller at the center

Fig. 5, Below—Interior view of 16-cam timing mechanism controlling cycling of adsorption equipment

Fig. 6, Above—Three-way diaphragm valves which control hydraulically operated adsorber valves; at the right, base of the acetone refining column



tight. Special design of the hydraulic cylinders enables the valves to be opened or closed completely in less than 15 seconds.

Instrumentation of this plant by the designers in collaboration with the Bristol Company has resulted in the novel assembly of control and recording devices shown in the accompanying illustration of the instrument panel (Fig. 4). The brain of the operation control equipment is, of course, the timing mechanism which actuates the hydraulic valves and the blowers in the proper sequence. This process controller is located centrally at the bottom of the panel. The inside view of the controller is shown in Fig. 5. The single shaft which operates the multicam unit is turned by a synchronous motor through a spur-and-worm reduction gear on a cycle which repeats at set intervals. By the rigid interconnection of the cam mechanisms absolute interdependence of the valve mechanisms is achieved and the desired succession of operation becomes certain.

Of the 16 cams, 14 serve to actuate three-way air-pilot valves (Fig. 6) which operate three-way diaphragm valves on the 100 lb. hydraulic lines. The latter valves open and close the gate valves of the main apparatus. One of the cams works through an air-operated mercury contact tube for opening and closing the electric circuit to the cooling blower. There is no cam to actuate the adsorbing blower circuit since normally this blower operates continuously during the time the plant is running. However, when the plant is shut down the blower is automatically stopped when the rest of the mechanism ceases to function. Furthermore, it may be controlled manually if for any reason it is desired to shut it down during plant operation.

Shutdown may be accomplished by a manually operated valve which exhausts the controlling air supply, thus permitting instantaneous shutdown when desired. However, at the end of the operating shift the valve which is controlled by cam No. 16 on the multicam controller comes into action. It is so designed that as the time for closing down approaches, the operator turns this unit to the stop position. This does not cause immediate shutdown, but does provide for closing off of all parts of the mechanism in proper sequence at the correct instant in the operating cycle. The importance of closing down at night in this manner has already been explained.

The air flow, steam flow and temperature control mechanisms are actuated by pneumatically operating recorder-controllers of the free-vane type. The chart records enable the operator to check quickly the prevailing conditions and serve as permanent records of the daily operation of the plant. These recorders are located in the panel shown in Fig. 4.

All of these automatic devices are also so connected with mechanism for manual operation as to permit hand control either for checking purposes or for use during an emergency. If desired, the multicam controller itself may be rotated by hand. Signal lights on the panel show the operating status of the various parts of the mechanism. Emergency signals show when either the reserve air-tank pressure has dropped below a proper point for

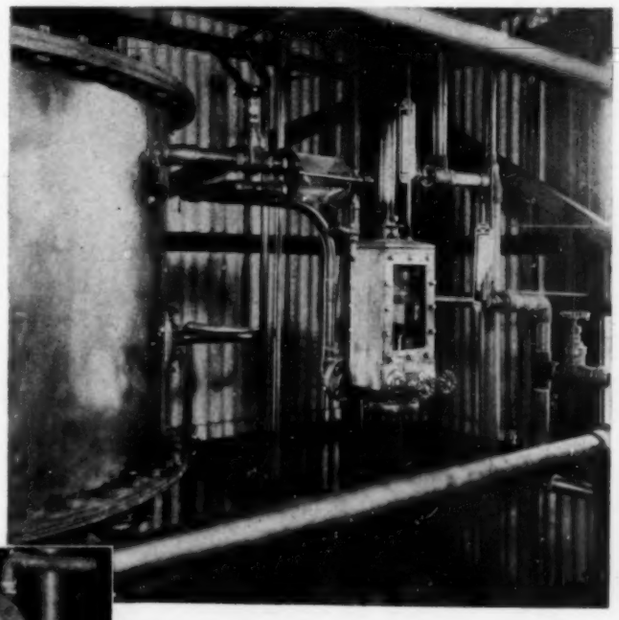


Fig. 7—Vapor condenser and condensate cooler which condenses steam-solvent mixture discharged from the adsorbers

Fig. 8, Upper Right—Gravity decanter where the acetone-water solution is continuously separated from the hexane

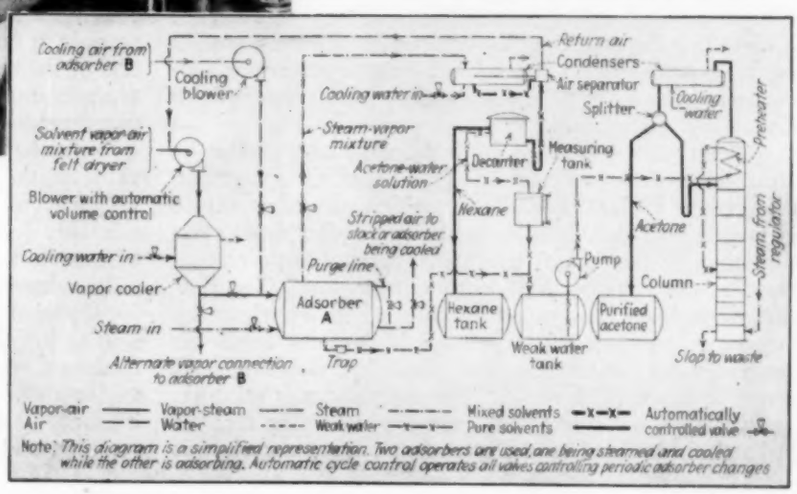


Fig. 9—Simplified flow diagram of adsorption and acetone-refining plant

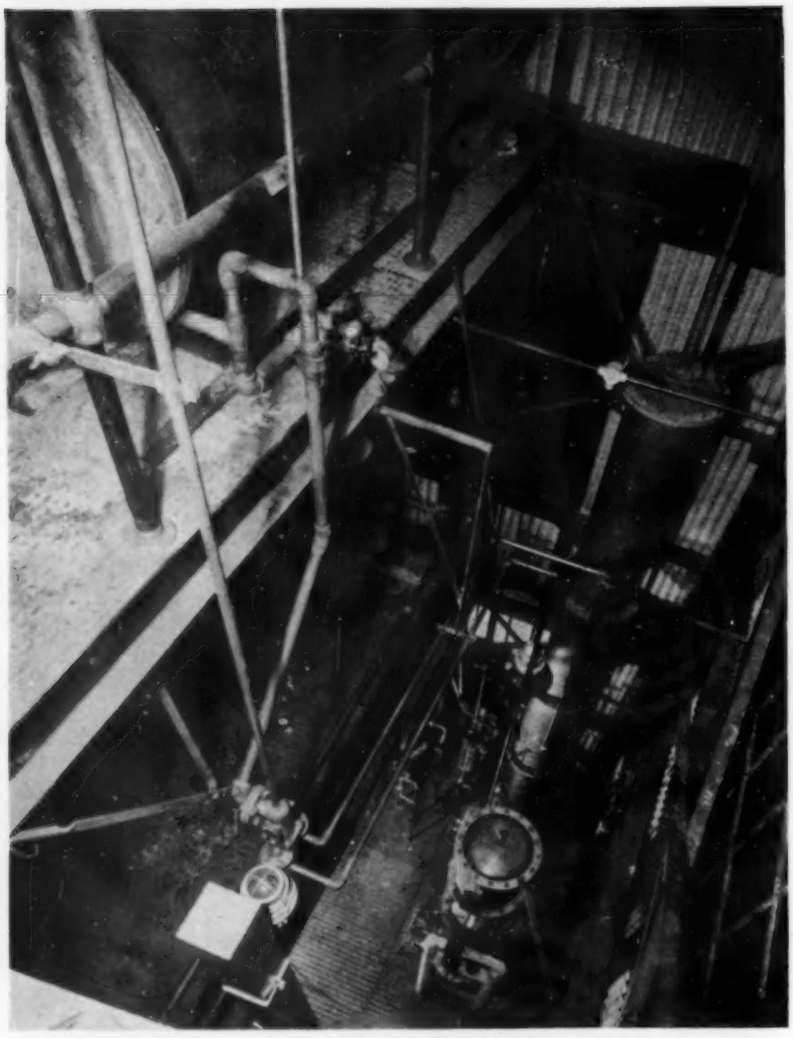


Fig. 10—Looking down on the acetone column, showing condenser, reflux splitter, steam regulator, feed flow rate indicator and other control devices

functioning or when the power supply to the multicam controller fails.

Sweated copper piping has been used for the water and solvent lines throughout the plant. The extra initial cost for material which this involved has, according to the local management, been much more than offset by the convenience of initial installation and the permanence achieved. The striking appearance which this copper piping contributes to the solvent recovery room is evidence to the visitor of the meticulous care taken in both design and installation.

Solvent vapor removed from the adsorbent carbon by steam is conveyed to a tubular type vapor condenser and condensate cooler (Fig. 7) in which the temperature is maintained by automatic control of water flow. Air displaced by the steam is returned through an air separator to the inlet of the adsorber in service. The condensate is passed through a decanter (Fig. 8) where the hexane is continuously separated by gravity from the acetone-water solution. The first hydrocarbon goes direct to storage for reuse. The acetone-water mixture, or "weak water," is handled through a measuring receiver in batches, dumped by the attendant once per cycle. It goes to an inter-process storage tank from which it is subsequently pumped through a Rotameter flow gage to the preheater in the top of the rectifying column (Fig. 10). A standard copper rectifying and exhausting column recovers acetone of 99.8 per cent concentration and discharges the water to waste. The recovery is between 98 and 99 per cent of the solvent delivered to the adsorbers.

Maintenance of the refinery unit with tight connections throughout is necessary to minimize loss during refining. What might be called a completely closed cycle of operation is provided. In other words, at all points where minor vapor loss might occur, incident to necessary venting, the vents are not discharged to the air but are returned to the inlet of the adsorbers. Thus when the apparatus is working at full scale, one cannot detect at any point in the plant even a slight odor of acetone. This is a very crude, but none the less effective, nose test. It shows why high recovery has been achieved. Most of the vapor losses which occur are due to occasional opening up of the dryer during operation of the impregnation unit.

Despite substantially vapor-tight operation at all times, the design of the plant has taken into account every possible contingency which may arise on account of vapor leakage. Flame arresters and fire checks required for safety have been introduced in generous measure. All of the motors, line-starters, switches, lights, and so on, are of the explosion-proof type. Even in the event of a serious breakout of vapor or liquid spillage, there would be no source of ignition to cause fire or explosion.

The important effect of automatic operation and control of a solvent recovery plant is to maintain a high recovery efficiency at a minimum cost. Such a plant can be operated with complete safety under optimum conditions at all times. The successful operation of the plant is in no wise dependent upon the skill or the attention of the operator. Wastage of steam, water and power are prevented and thus cost of operation is reduced to a minimum.

With the plant operating at its rated capacity the net value of the recovered solvent or the net profit will be sufficient to pay for the complete installation in considerably less than one year. The recovered solvent is, of course, reused in the process of producing box toes.

In acknowledgment, the writer wishes to express his appreciation to the Endicott-Johnson Corp. for permission to inspect the plant, and to engineers of Carbide & Carbon Chemicals Corp. for assistance in preparing the manuscript. Both the equipment and the adsorbent used, it should be noted, are covered by U. S. patents issued or pending, and owned or controlled by the designing firm.

Is There a Profit in Chlorine And Nitrate From Salt?

By F. W. DE JAHN
Chemical Engineer, New York, N. Y.

Present market relations between chlorine and caustic soda have revived interest in processes for producing the first of these chemicals without the second. *Chem. & Met.* asked Mr. de Jahn, who has given considerable thought to the subject, to set down some of his calculations and speculations. His conclusions appear below.—*Editor*

CHLORINE, at present, is manufactured by the electrolysis of sodium chloride brine, with the simultaneous production of 35.5 parts of chlorine gas and 40 parts of caustic soda. The process is undoubtedly an ideal one when both products can be sold at fair prices. But caustic soda is also produced by causticizing soda ash and the caustic market does not at present absorb the entire output of both processes. On this account other processes for making chlorine without the simultaneous production of caustic soda have become of great interest, among them the proposal to decompose salt with nitric acid.

Why this particular process is of interest hinges on a situation in the synthetic ammonia industry. In order that ammonia plants may operate at full capacity, and produce at competitive manufacturing costs, additional outlets for ammonia are important. Cheap synthetic ammonia can readily be converted into nitric acid and such acid has for some time been used in producing sodium nitrate. Unfortunately, the world price for sodium nitrate has been depressed to a point where its synthesis in this manner probably is not a very profitable operation. With the present market price of about $24 per ton of $NaNO_3$, the ammonia has to be charged to the process at such a low figure that the margin of profit may not warrant the investment necessary for a new plant.

When sodium chloride is substituted for soda ash, however, the economics of sodium nitrate production becomes entirely different, as will be shown later. A cheaper source of sodium-ion is thus employed and, in addition, chlorine becomes one of the joint products of the reaction.

When sodium chloride reacts with nitric acid, the hydrochloric acid evolved is acted upon by the nitric acid with the formation of nitrosyl chloride, as follows:

$$3\,NaCl + 3\,HNO_3 = 3\,HCl + 3\,NaNO_3 \quad (1)$$
$$3\,HCl + HNO_3 = Cl_2 + NOCl + 2\,H_2O \quad (2)$$

Although the reactions are probably quite complicated, the net result might be expressed as follows:

$$3\,NaCl + 4\,HNO_3 = 3\,NaNO_3 + Cl_2 + NOCl + 2\,H_2O$$

This process has been known for a long time and was tried out with various modifications on a commercial scale in England over 40 years ago. In 1838 Watt and Tebutt proposed heating lead chloride or sodium chloride with nitric acid and in 1848 McDougal and Ramson proposed the same process. The reaction was investigated by Goldschmidt in 1879 and by Lunge and Pelet who tested it exhaustively in the laboratory in 1895, finding that the statement of Equation (2) was correct.

In 1847 Dunlop patented a process for making chlorine from salt and nitric acid. He proposed to treat the gases containing Cl_2, NOCl and NO (the last, an inevitable side product of the reaction) with sulphuric acid which would decompose the NOCl into chlorine and NO. The NO, in turn, would be absorbed by the sulphuric acid to form nitrosyl sulphuric acid. He proposed to wash the chlorine leaving the sulphuric acid scrubber with water to separate any HCl. This process was operated for some time at St. Rollox, England, but it was abandoned eventually on account of the enormous quantities of sulphuric acid used (2,000 tons of H_2SO_4 per 35 tons of chlorine).

In 1884 Taylor patented the treatment of HCl with cold nitric acid, obtaining two-thirds of the chlorine as such. The gas mixture containing Cl_2, NOCl, H_2O and NO he passed through 66 deg. Bé. sulphuric acid to decompose the NOCl into NO and hydrochloric acid and to absorb the NO with the formation of nitrosyl sulphuric acid. The gases leaving the sulphuric acid scrubber were again treated with nitric acid and again with 66 deg. sulphuric acid and this procedure was repeated a third time, whereby 96 per cent of the HCl was obtained as chlorine. The nitrosyl sulphuric acid was then denitrated with steam and air and the HNO_3 thus regenerated. Lunge and Pelet checked this process and found it was necessary to heat the nitric acid in order to react as Taylor stated, but if this was done, about 96 per cent yield of chlorine was obtained.

In 1887 Donald patented a process for treating HCl with HNO_3 of at least 1.4 specific gravity in two towers in series, then treating the gases with 66 deg. sulphuric acid and regenerating the HNO_3 from the nitrosyl sulphuric acid by means of steam and air.

In 1893 Vogt and Scott patented a process of treating HCl with HNO_3 continuously, passing a stream of 66 deg. sulphuric acid, with a superimposed layer of nitric acid, through their apparatus. The two acids were not mixed. HCl gas was passed over the top of the acid stream, all three acids running in the same direction and being kept at a temperature of 125 deg. C. The evolved gases were first scrubbed with 66 deg. sulphuric acid to decompose the NOCl and retain the NO. A water washer then followed to remove the HCl from the chlorine. Lunge and Pelet studied this process also and found good conversion into chlorine taking place. They stated, however, that there was a considerable loss of HNO_3 and stressed the high cost of regenerating the HNO_3 and concentrating the H_2SO_4.

In 1890 Davis patented a process for treating HCl with HNO_3 of a specific gravity of 1.4. He proposed to use five towers, in the first three of which nitric acid was to be used in treating first the HCl and then the evolved gases. The fourth tower was to be fed with 66 deg. sulphuric acid to clean up any NO and NOCl escaping from the third tower. Hydrochloric acid discharged from the first tower was remixed in the fifth tower with nitrosyl sulphuric acid from the fourth tower to effect a final recovery of HCl.

In theory the proposed process seems clear enough, but it is complicated by various side reactions. The main process is that of Equation (2) above. The NOCl evolved reacts with water and air, regenerating HNO_3 and HCl. The regenerated HCl reacts again with the HNO_3 so that the net result is the oxidation of the HCl by the oxygen in the air, with recovery of the HNO_3. The latter, at least in theory, acts only as a catalyst.

Davis gives the following equations to represent the process:

$$3\,HCl + HNO_3 = 2\,H_2O + Cl_2 + NOCl$$
$$NOCl + H_2O = HNO_2 + HCl$$
$$HNO_2 + HNO_3 = N_2O_4 + H_2O$$
$$3\,HCl + 2\,HNO_3 = Cl_2 + N_2O_4 + HCl + 2\,H_2O$$

The first two reactions are those principally taking place in the first tower. The gases leaving the first tower pass into the

Estimated Cost Per Ton of Chlorine or Sodium Nitrate by Nitric Acid-Salt Process

(Based on following constants per ton of chlorine produced: 1.94 tons HNO_3 at costs in table; 1.65 tons NaCl at $5 per ton = $8.25; $13.50 operating cost.)

Cost Per Ton NH_3	Cost of HNO_3 Per Ton Chlorine	Gross Cost	Net Cost* Per Ton $NaNO_3$	Net Cost† Per Ton Chlorine
$35	$36.08	$57.83	$11.85	$1.43
40	38.80	60.55	13.00	4.15
60	51.44	73.19	18.38	16.79
80	62.08	83.83	22.90	27.43
100	73.72	95.47	27.87	39.07

*Allowing credit of $30 for 1 ton chlorine against production of 2.35 tons $NaNO_3$.
†Allowing credit of $56.40 for 2.35 tons $NaNO_3$ at $24 per ton.

second and third towers where they are treated with HNO_3 and air. The water solution of HCl leaving the bottom of the towers goes to the fifth tower. A number of other reactions are listed as taking place:

$$3\,NOCl + 3\,HNO_3 = 3\,HCl + 3\,N_2O_5$$
$$3\,N_2O_5 + 3\,O_2 + 3\,H_2O = 6\,HNO_3$$
$$3\,HCl + HNO_3 = 2\,H_2O + Cl_2 + NOCl$$
$$2\,NOCl + 3\,HNO_3 + 3\,O_2 + H_2O = 5\,HNO_3 + Cl_2$$

In other words, the HNO_3 and the NOCl are both oxidized by the oxygen in the air to Cl_2 and HNO_3.

These equations emphasize the heterogeneous character of the reactions occurring in the three nitric acid towers. Some of the NOCl is converted to HNO_3 and HCl. Further NOCl reacts with the HNO_3 to produce N_2O_5 which in turn is oxidized HNO_3. Undoubtedly some NO is produced and additional NOCl passes into the fourth or sulphuric acid tower with the NO where the two are converted to nitrosyl sulphuric acid. In the fifth tower, the HCl from the nitric acid towers is mixed with the nitrosyl sulphuric acid to release chlorine and regenerate HNO_3. The HNO_3 is recovered from the sulphuric acid by denitration and any remaining HCl is removed from the chlorine leaving the last tower by washing with water.

None of these various processes has been effective in the production of chlorine prior to the present, on account of the high cost of nitric acid and the technical difficulties incident to carrying them out. In recent years, however, the cost of synthetic ammonia has reached a point where it is possible to produce nitric acid at a price entitling such a process to serious consideration.

In order to picture the economic possibilities of the production of chlorine and nitrate of soda from nitric acid and salt, the calculations summarized in the accompanying tabulation have been made. Ammonia has been entered at costs ranging from $35 to $100 per ton. The lower figure approximately corresponds to the manufacturing cost, including a nominal charge for depreciation and obsolescence. The higher figure is the approximate sales price of liquid ammonia. The cost of nitric acid is figured to include conversion cost by a pressure oxidation process producing acid of about 62 per cent HNO_3. $5 per ton for salt may be low in some localities and high in others.

The operating expenses have been estimated by taking into account the various steps in this process such as:

1. Decomposition of the salt with nitric acid.
2. Conversion of the nitrosyl chloride into HNO_3 and chlorine.
3. Recovery of the NO as nitric acid.
4. Washing the chlorine with water to remove whatever HCl it contains.
5. Drying the chlorine gas.
6. Liquefying the chlorine gas.
7. Crystallizing and evaporating the sodium nitrate solution.

The figure of $13.50 estimated for the operating cost should be considered only as a reasonably good guess as it is obviously impossible, in considering a process of this kind, to arrive at the correct figure without actually having a plant in operation. This is particularly the case in a process involving so many technical difficulties. The credit of $24 per ton for sodium nitrate, taken as a reasonable selling price, may be somewhat high, but consideration has been given to the possibility that better prices may be obtained in the future. Applying a reasonable selling price for chlorine of $30 per ton, the table has also endeavored to show the cost of nitrate of soda. This credit may vary slightly, depending on freight rates.

On the whole, however, the estimates given in the table do show the possibility of producing cheap chlorine with simultaneous production of nitrate of soda for which there is a ready market at about the indicated price. It is the author's opinion that the two lowest chlorine costs probably are not possible of realization. However, if the technique and equipment are perfected and the ammonia is put in at a figure which allows a fair interest and depreciation on the investment in the plant, then the cost of chlorine, crediting nitrate of soda at $24 per ton, should be in the neighborhood of $10 a ton.

It is possible that the operating cost of $13.50 per ton of chlorine may be somewhat too low. This should include a 15 per cent depreciation and 6 per cent interest on the investment. Even if the figure were increased somewhat, the process would still be of great economic value.

In considering how this process could be carried out on a manufacturing scale, it is clear that there may be many difficulties from a corrosion standpoint. Ceramic ware or brick-lined metal probably will offer the answer so far as most of the equipment is concerned. On account of this materials problem, units would probably have to be made in rather limited capacity. Furthermore, great difficulties would result from the fact that air has to be admitted to complete the oxidation of the NOCl and that air would also be drawn into leaky joints as the whole equipment would have to operate under suction. Additional complication would result if the acid had to be heated as Lunge and Pelet have stated is necessary. The chlorine produced would be diluted with air and nitrogen which would cause complications in liquefaction of the chlorine. If sulphuric acid had to be used to clean up the final nitrosyl chloride, the denitration of this acid would have to be carried out, which would mean recovery towers for converting the nitric oxides into HNO_3, denitrating columns for nitrosyl sulphuric acid and concentrating equipment for the sulphuric acid itself.

There would also be produced, in all likelihood, some 20 per cent HCl which is the constant boiling mixture of this acid. This would have either to be disposed of or to be put back into the process or decomposed with strong sulphuric acid, the latter requiring reconcentration.

An interesting fact is that if one starts with nitric acid of 63 per cent HNO_3, both in the decomposition apparatus and in the treatment of the nitrosyl chloride, this acid will actually increase in strength until it gets to a point (69 per cent HNO_3) where water has to be added. If this is not done the N_2O_4 will not react with the water in the acid. The water in the nitric acid will, of course, ultimately leave the system with the nitrate of soda and as this will undoubtedly contain some nitric acid, it is likely that some sodium carbonate will be needed to neutralize the acid before the nitrate of soda can be handled in crystallizing and drying equipment.

All in all, the process is not one to be undertaken lightly. Nevertheless, with modern technique and modern equipment and materials available, the difficulties should not be insuperable. In the author's opinion, a successful and economic adaptation of the process is entirely possible.

Drying Heavy Leather In Five Hours

By T. K. SHERWOOD and L. E. GARONO

Department of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Mass.

FROM the physical viewpoint, the drying of heavy leather would seem to involve no special difficulties. The material is porous, and no more hygroscopic than many other things which may be dried easily. In practice, however, it has been found necessary to dry sole and belting leather at temperatures very little above room temperature, and so prolong the drying time to about eight days. Eight days to vaporize the water from a wet porous material less than half an inch thick!

The reason for the care required is that the water in the leather is not pure water, but contains dissolved tanning materials. As the drying proceeds the solution is drawn by capillarity to the surface of the hide, where the water evaporates, leaving a deposit of tannin. This small surface deposit turns black if the air used is above about 90 deg. F. The surface is not only discolored but is very brittle, and when dry the leather is easily ruined by flexing the stiff product. Drying at a low temperature obviates these difficulties, but suffers the severe disadvantages of long drying time, large floor space requirements, large inventories, large steam consumption owing to the enormous quantities of air required, and difficulty of drying during humid periods.

A new process developed by the writers (patent applied for) overcomes these difficulties by a device which is both simple and effective. The wet leather to be dried is coated with a thin layer of a kieselguhr-water paste. As the coated hide is dried, the water moving through the porous leather does not stop at the surface of the hide, but is drawn by the strong capillary pull of the kieselguhr coating into the wet paste, evaporating at the outer surface of the coating. The tannin substances in solution are deposited on the surface of the coating and not on the surface of the leather; since this coating is later removed, it does not matter that the deposited tannin turns black. Thus, it is possible to dry the leather at temperatures as high as 180 deg. F. without discoloration or other injury of the product. The kieselguhr coating peels and begins to fall off before the leather is dry, but not before the leather is dry enough not to be subject to injury by the high temperature. At high temperatures the drying time is very short; sole leather bends have been dried in this way at 156 deg. F. in 5½ hours in a commercial dryer. The finished product is practically indistinguishable from the product dried in the old way—perhaps even a little better.

The paste employed may contain a small proportion of bentonite to make it somewhat gelatinous so that it will not run down the wet face of the hides hung vertically in the dryer. The paste may be applied by brushing or dipping, but is most easily applied by spraying with a pressure-cup type spray, since the thickness of the required coating is less than $\frac{1}{32}$ in. The kieselguhr may be recovered after drying.

The 97 per cent reduction in drying time makes it possible to dry several hundred bends per day in a relatively small dryer. At the high temperatures employed, air has an enormously greater carrying capacity for water vapor, so that relatively little air need be handled and the steam consumption is less than for low temperature drying. The large inventory is practically eliminated and the drying operation is influenced to a negligible degree by variations in atmospheric humidity.

An illustrative calculation of the steam saving possible by drying at the higher temperatures is given below. Air supplied at 60 deg. F., with a relative humidity of 50 per cent, and leaving at 90 deg. F., with a relative humidity of 50 per cent, picks up approximately 0.01 lb. of water per pound of dry air. Thus, 100 lb. of dry air is required per pound of water evaporated and the heat carried out by the hot waste air is $100 \times 0.24 \times (90\text{-}60) = 720$ B.t.u. per pound of water evaporated. Air supplied at the same temperature and humidity, but leaving at 160 deg. F., with a relative humidity of 50 per cent, picks up approximately 0.115 lb. of water per pound of dry air. Thus, 1/0.115, or 8.7 lb. of dry air is required per pound of water evaporated and the heat carried out by the hot waste air is $8.7 \times 0.24 \times (160\text{-}60) = 209$ B.t.u. per pound of water evaporated. The sensible heat lost in the waste air, which is the major heat loss, is reduced by over 70 per cent.

Injection Molding Gains in Use

INJECTION MOLDING for thermoplastic molding compounds, notably cellulose acetate, is now coming into extensive use, particularly for the fabrication of articles which by reason of complications of design cannot economically be made by the conventional technique of compression molding.

In contradistinction to compression molding, in which a weighed amount of molding compound is placed in an open mold and the mold then closed by hydraulic pressure, injection molding involves the use of a mold initially closed, and connected by a duct to a chamber containing the molding compound maintained in plastic condition by heat. The thrust of a plunger upon the mass in the heating chamber forces material through the duct to fill the mold. Essential to the process is a constricted orifice leading from the heating chamber into a duct of small diameter, which constriction assists in heating and homogenizing the mass and permits ready removal of the sprue. For rapid operation the process uses an unheated mold, wherein the compound hardens almost instantaneously by chilling. The cycle of operation thus becomes very short compared with compression molding, in some cases offsetting the greater capacity obtainable in compression molding equipment.

Essential features are covered by U.S.P. 1810126, which is controlled by the du Pont Viscoloid Co.

A modification of this process, designed primarily for heat-setting molding compounds, is known as transfer molding (U.S.P. 1916495, 1919534). Here the charge in the heating cylinder is limited to that required to fill the mold once. The system is completely emptied after each cycle so as to prevent blocking of the duct by hardened plastic. The mold is kept hot in order to effect the necessary hardening of the article.

By JAMES A. LEE
Managing Editor of Chem. & Met.

Bakelite's Anniversary

Dr. Leo H. Baekeland, after developing the phenolic resinoid, founded the General Bakelite Co. in October, 1910

FROM a small rented building with a second-hand steam engine and a 40-gal. still to a vast modern plant covering 125 acres which boasts a capacity of 50,000,000 lb.; from a new product for which a market had to be found to a series of products for which there is a demand from almost every known industry the world over, is the record of the Bakelite Corporation in the short period of 25 years. Is it any wonder that Dr. L. H. Baekeland, inventor-president, and his associates are proudly celebrating the anniversary of the founding of the company on Oct. 10, 1910?

Five years earlier the brilliant inventor had become interested in the insoluble, infusible, porous mass Kleeberg had reported which had been carefully avoided by other early experimenters. He began by reviewing the work and repeating the experiments of his predecessors. Before the end of 1907, Dr. Baekeland had been so successful with the development of the resinoid that he had already started the manufacture of the new product on a limited scale in the Yonkers laboratory. The first customers were Richard W. Seabury of the Boonton Rubber Co. and Edward Weston of electrical instrument fame, and shortly afterwards Westinghouse Electric & Mfg. Co., General Electric Co., Continental Fibre Co., S. S. White Dental Mfg. Co. and others.

Since in the summer of 1910 demand for the product had outrun the small capacity of the semi-plant scale still, he decided to organize the General Bakelite Co. and cast about for a suitable location to begin production of Bakelite in large quantities. The name had been given the resinoid by Dr. Baekeland's associate, C. P. Townsend, inventor of an electrolytic cell.

Formaldehyde, one of the important raw materials of Bakelite, was being manufactured in Perth Amboy, N. J., by the Roessler & Hasslacher Chemical Co.; and since it seemed advisable to locate near the source of raw material, a building was leased from this company in 1910 and the manufacture of Bakelite transferred from Yonkers to Perth Amboy.

About this time others became interested in the phenol-formaldehyde resinoid. One of these was J. W. Aylesworth, a chemical consultant for Thomas A. Edison. He saw the possibilities for making improvements in phonograph records out of the new material. And soon afterwards the Condensite Co. of America was established to exploit the inventions of Aylesworth.

In Chicago, Adolph Karpen, a member of the firm of S. Karpen Bros., had the idea that this material might be used to produce superior varnishes for his furniture. He established the Robert Kennedy Duncan Industrial Fellowship at the University of Kansas and selected Dr. L. V. Redman for the fellowship. A short time later A. J. Weith and F. P. Brock joined him.

From the very beginning the predecessors of the Bakelite Corp. grew rapidly. Before 1913 General Bakelite outgrew its original rented quarters, added two one-story extensions, later built a separate building, then a three-story building, to which was added a great deal more floor space as time went on. In 1913, preliminary work at the University of Kansas having been completed, Dr. Redman, Weith and Brock moved to the Chicago plant of S. Karpen Bros. and began development of their process, but soon had to take much larger quarters across the street. Condensite began in Edison's Glen Ridge, N. J., plant, but in 1914 moved to much larger quarters in nearby Bloomfield, and later added floors and additional buildings.

In March 1922, after the final termination of patent suits, Condensite and Redmanol Chemical Products were combined with the General Bakelite organization to form

the Bakelite Corp. For several years each division continued to operate in its former location, but by 1929 all three factories were so crowded for space that a 125-acre site at Bound Brook, N. J., was chosen for the erection of a modern plant, designed especially for the production of Bakelite products. When this plant was completed in 1932, both the Perth Amboy and the Chicago factory were abandoned, all research and development work had been previously assigned to the Bloomfield plant, where at present a large staff of chemists and engineers devote their efforts exclusively to the creation of new materials and processes for industry.

The new plant is composed of many buildings housing the various departments. These structures have been arranged about the large acreage of land so that the capacity of each one may be increased when the demand requires it. In fact, although the plant has been operating only a few years, two or three extensions have already been made.

The company operates a fleet of 25 tank cars that are used for transferring the alcohol, cresol, formaldehyde, and phenol to the plant. These liquid raw materials are stored out of doors in very large tanks. When the phenol is received in the colder weather the tank cars are run into a brick building where the contents are warmed sufficiently to pump into the storage tanks outside. The phenol in two of the tanks is kept in a liquid condition at all times for daily consumption. These tanks are supplied from the other tanks as necessity arises.

The alcohol storage tanks have been placed some distance from the buildings so as to prevent damage in case of fire. The pipelines connecting these alcohol storage tanks in the yard with the processing buildings are held on 6-ft. supports so that they may be readily inspected for leaks and repaired with as much haste and ease as possible.

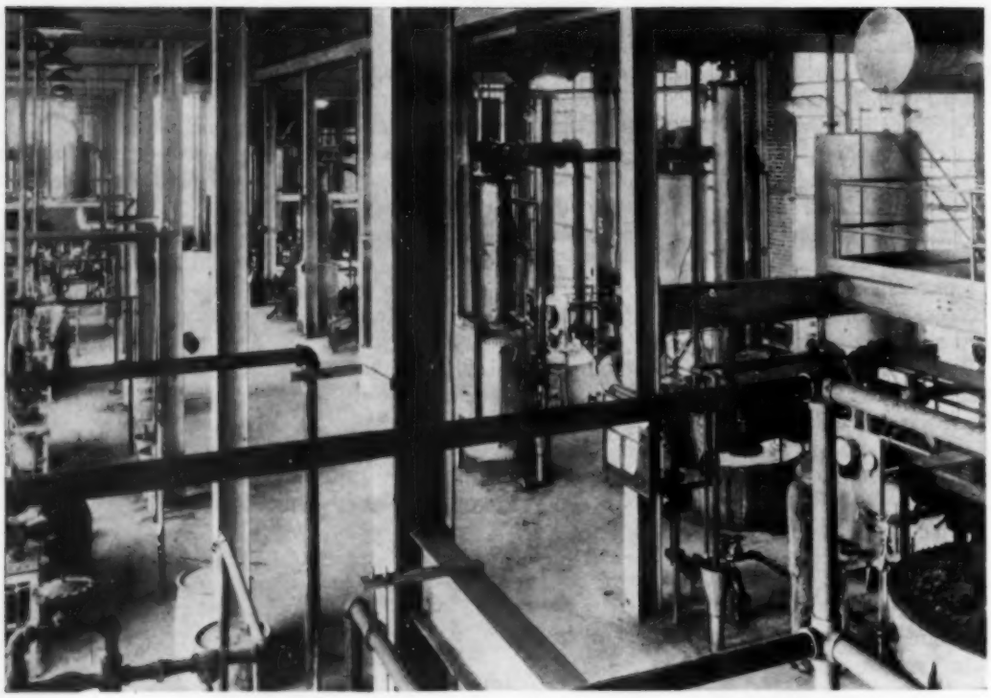
A feature of the plant is the underground tunnel which is used for the pipelines conveying the various other liquid raw materials from storage to processing, the resin varnish to storage, and the water and steam lines radiating out from the power house to the many buildings. The passage is about 10 ft. high and 13 ft. wide, and well lighted. This arrangement affords easy inspection and maintenance. The solid raw materials, such as wood flour, asbestos and dyes, are received at the plant in railroad boxcars and are unloaded with the help of conveyors into a large warehouse.

The principal unit of the entire plant is devoted to the production of the basic synthetic resin which is sold as clear resin, or mixed with fillers and dyes for molding purposes, or converted into laminating varnishes and other special products. This unit is housed in a three-story brick building and the equipment arranged to take full advantage of gravity and straight-line flow of materials.

The liquid raw materials are forced up to the third floor from the storage tanks in the yard by remote controlled pumps. Here these materials are received in any

First semi-commercial unit at the Yonkers laboratory. Retired from active service, it now occupies a place of honor at the modern plant at Bound Brook, N. J.

Dr. Baekeland first made the phenolic resinoid in his Yonkers, N. Y., laboratory (right). In the summer of 1910 demand exceeded capacity of facilities and General Bakelite Co. was organized. Its first home was a rented building at Perth Amboy, N. J.



In the still room primary resins are produced for use in molding materials, varnishes and other products. Each still is equipped with delicate instruments to insure control and to provide an exact record of every batch of resin

one of four sets of weigh tanks. These scale tanks are connected to a printing device which automatically and mechanically selects and prints the correct weight of each chemical raw material on a printed form by the touch of a button, thus eliminating all possible weighing error ordinarily introduced by the human element. The weight of each chemical must correspond to the quantity previously indicated on the form by the foreman. Every weigh tank has a set of pipelines connecting it to each of the stills on the floor below.

The reaction between the formaldehyde and phenol or other chemical to form the resinoid is carried out in large copper or steel stills. The condensers attached to the stills are made of copper to prevent discoloration of the products. Likewise the charging tanks are made of the same metal. These tanks are used to hold the raw materials for the next batch of resin. By the use of these tanks the weigher on the floor above can have the entire charge of 450 to 600 gal. of chemical raw materials for a batch weighed and ready to run into the still as soon as it is emptied of its processed resin, so that no time is lost in the use of the still. The processing is carefully controlled by a set of recording instruments on a panel adjacent to each still.

The industry has become one of custom made products in which special requirements are met by special properties in the material. In other words the demands of the trade have exacted special materials for special uses, instead of one standard type of material for all uses. For this reason three service laboratories are employed in connection with the control of the products of the still room adjacent. They are used for checking the raw materials and the finished products. In one of the laboratories a sample of each batch of resin is used for converting into lamination varnish, mixed with a filler and made into molding powder or other product, for which the particular batch of resin will ultimately be used. This accurate control of processing is characteristic of the entire Bakelite plant.

The bottom of each still projects through the floor so that the contents may be drained out by means of a valve in the bottom into pans on the floor below. The pans have a capacity of 500 lb. of resin and may be handled and stacked by means of an electric lift truck. They are so constructed that they may be easily stacked until the resin has cooled and solidified.

The hardened resin is dumped out and broken with sledge hammers. From this point it follows one of two paths, depending on its ultimate utilization. If intended to be sold as resin, it is crushed and pulverized in a large tube mill and carried in a conveyor up four floors to an air separator, finally falling to a vibrating scalping screen below, where the last traces of lumps may be removed, and returned to the tube mill. The finely ground resin passes to a blender and is packed from the blender into drums for shipment.

The resin intended to be compounded into molding material passes through a coarse grinder and is blown up through a six inch pipeline into storage bins on the top of the building. The wood flour, asbestos or other filler is forced up in like manner in an 8-in. pipeline into 15,000 lb. storage bins. Sufficient resin and filler are conveyed to the bins at one time to make a carload of finished material. The supply tanks operate through mechanical feeders delivering ground resin and wood flour or other fillers, into weighing hoppers, and then down through magnetic separators into mills which pulverize the resin and filler mixture to 100 mesh. From the pulverizer the materials continue their journey downward, going next into 2,000 lb. mixers where the dyes are added. When thoroughly mixed the batch drops down below to agitator storage bins and from these

storage bins it feeds down onto heated roller mills which further increase the uniformity of the blended mixture. At regular intervals the thick blankets of hot material are removed to a second heated roller mill where they are given a further mixing before being dropped onto the steel chain conveyor.

While the blanket is still on the conveyor it becomes partially cooled and solidifies. It is then broken into pieces and drops onto a belt conveyor which passes it through a crusher. The crushed material is then elevated in a bucket conveyor to the top floor of the building where it is passed through a hammermill and a vibrating screen into two 6,000 lb. tanks and then into 6,000 lb. revolving blending tanks.

Much emphasis is put upon uniformity of product, and therefore when material for a carload shipment is prepared an equal quantity of resin is withdrawn from each of eight storage tanks. It is fed into mixing conveyors, then into a cascade mixer, through a magnetic separator, and a vibrating screen for scalping any foreign matter that may be present in the granular material. Continuing its downward journey it passes through a chute and is loaded into 300 lb. plywood drums. These are delivered to the loading chute by means of a helical conveyor which places the drums in position as they are consecutively filled.

Colored resins other than black and brown are prepared in another department so as to prevent these stronger colors contaminating the more delicate ones. These materials are made only on order. In general, the processing is similar to that of the darker colors which has already been described; however, since the lighter colors are used in smaller quantities, the equipment in this department is on a smaller scale. To prevent contamination among the light colors each one is processed in a room of its own. And as the demand for the various colors differs somewhat in quantity the capacity of the several equipment units necessarily vary in size.

The type of equipment found in this department differs slightly; for instance, attrition mills are used for pulverizing materials as they are more easily cleaned, and revolving hollow shells are used for blending the larger batches and ball mills for batches ranging in size from 500 to 1,000 lb. Like nearly every department in the plant this one includes several laboratories whose principal duty is to see to it that the color of the various batches of resin being processed match the color standard ordered by the customer, which is not an easy task.

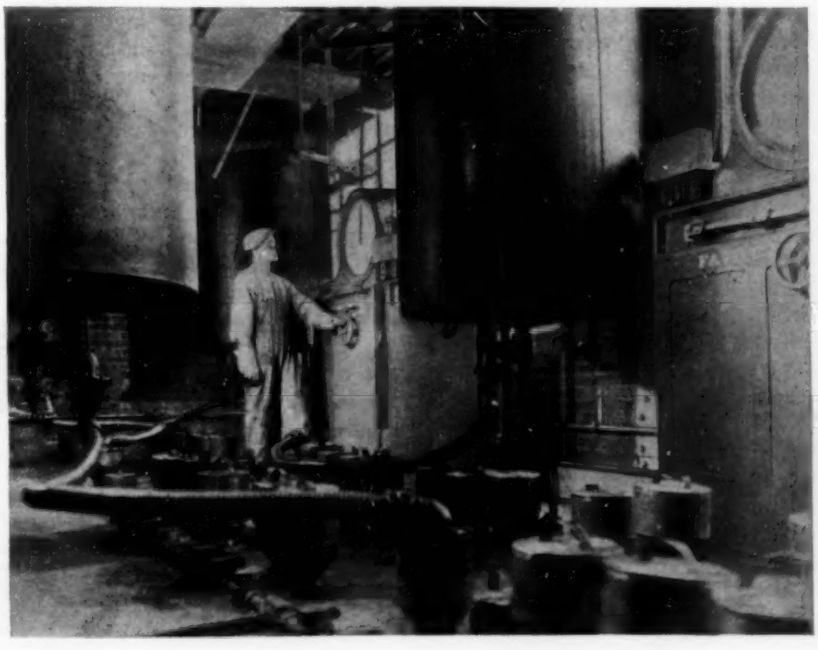
Much of the resinoid manufactured in the Bakelite plant is converted into varnish for shipment to other companies for impregnating paper, duck and other materials that are made into laminated products. Alcohol is added to the resin to be used for varnish while it is still in the kettles. And after mixing it is pumped through a pipeline to the varnish storage tanks holding up to 300,000 lb. each. These are housed in a building some distance away where the blending and coloring operations are done. After the varnish is passed through filters it is shipped either in steel drums or tank cars. The latter are loaded while standing on a track alongside the building. Every drum is reconditioned and carefully washed before it is used, a special building nearby being used for this purpose.

While the solid resins discussed thus far have been for molding purposes, Bakelite has always manufactured the cast type of resin. However, the production of this variety is done on a smaller scale. Due to the different nature of this type of resin it is produced in a department of its own. Here batches of from 600 to 700 lb. each are processed in nickel or stainless steel stills equipped with stainless steel horizontal condensers. While some batches of resins are processed under vacuum, others are treated in open nickel kettles. The completed resin is drawn off and poured into lead molds and cured in ovens for from four to five days.

One of the newer products of the Bakelite company is the air drying resin used for compounding paints, varnishes and lacquers. This is made in a special department and in equipment similar to that to be seen in the general resin department already described.

No description of this extensive and almost self-contained organization would be complete without at least mention of the modern power plant that is the very heart of the entire plant, the engineering and drafting departments, the machine shops where some special equipment is fabricated and all is maintained in operating condition, the service organization which is responsible among other things for handling all trucking about the many buildings and grounds, the meter repair and standardization department, and finally the assembly of the plywood drums in which much of the product of the plant is shipped to the ultimate consumers to be converted into an almost limitless number of objects.

Liquid raw materials are automatically weighed and recorded before being transferred to stills below



Courtesy of Bakelite Corp.

Burlap Bags for Bulk Chemicals

By R. W. LAHEY
American Cyanamid Co.
New York, N. Y.

BURLAP BAGS occupy a humble position in the packaging world—they are the plodders or draft horses of the industry. We are all familiar with the burlap bag in one or more of its many uses. Probably we have a few in the cellar holding potatoes, apples or onions. There are usually a few in the garage, placed there for safe keeping against the time that there may be a need for them. After they are worn out in bag service, they are turned over to some other job. There is always a ready market for used burlap bags and they are continued in service until too far gone for further use as bags; they are then cut up and used as barrel covers, for wrapping roots of nursery stock, and the like.

These lowly containers occupy an important position in the chemical trade. They are used wherever powdered or lump materials are packed, for they are one of the cheapest and most durable packages that can be chosen.

Bags may lay claim to the distinction of having been the first containers used, as they are referred to in the Old Testament of the Bible as "wine skins." Today, we have many types of bags to choose from. They are made plain and combined with paper. It is therefore extremely important that all shippers have a comprehensive knowledge of these bags and what can be expected of them.

Burlap bags made from jute are more universally used in the chemical industry than cotton bags because they can be obtained at a lower price for equal strength. In those instances where cotton bags are used, it is largely to prevent the slight contamination that may occur from jute fiber.

As we all know, jute is cultivated in India. It is the fibrous part of a plant which grows from 5 to 15 ft. high. The fibers are located between the outer covering or bark and the stalk of the plant, and in order to remove them from the stalk they are immersed in water from 8 to 30 days. The process is called "retting."

The fibers are classified as to grade and color by the farmers, bundled and baled and then sold under quality guarantees. Most jute is converted into cloth in India, but some is exported in bales to Scotland, Czecho-Slovakia, Austria, Hungary, Belgium, Germany and Italy where it is twisted and woven. The fibers are first softened by crushing and lubricating with oil and water. Then one or more grades are blended to obtain the proper mixture. The next step is to card and draw the

Approximate Tensile Strength of Burlap

Construction	Count		Tensile Strength	
	Porter	Shot	Porter	Shot
7½ oz. Calcutta	9	9	65	50
8 oz. Calcutta	9	10	65	60
10 oz. Calcutta	11	12	73	80
10 oz. Continental	10	12	87½	74½
10½ oz. Calcutta	11	12	79	83
11½ oz. Continental	11	12	77½	92½
11½ oz. C & M Continental	11	12	94½	107
12 oz. Calcutta	11	12	85	120
12 oz. C & M Continental	11	12	89½	150
14 oz. Calcutta	11	13	96	143
14 oz. C & M Continental	11	13	96	140

Calcutta Burlap Shipments to the United States

Weight Ounces	Width Inches	Yards Shipped 1934	Yards Shipped 1st 6 mos. 1935
5½	32	1,866,500	813,300
5½	37	360,000	326,700
7	32	.....	250,000
7	36	3,960,000	3,990,000
7	40	1,540,000	520,000
7	52	100,400	200,500
7½	32	1,414,000	200,000
7½	36	29,898,000	11,180,000
7½	40	155,888,000	99,516,000
7½	45	16,288,200	6,734,000
7½	48	2,145,600	680,000
7½	50	924,400	650,300
7½	52	300,000	200,300
7½	54	1,399,500	1,280,100
7½	56	100,000	90,000
7½	60	1,175,100	372,000
8	27	50,000	.....
8	32	490,000	10,000
8	36	52,102,100	22,620,400
8	40	50,182,000	30,780,100
8	45	1,460,000	836,000
8	48	154,000	144,000
8	50	.....	50,000
8	54	240,000	40,000
8	60	140,000	33,000
8	72	100,000	10,000
8	36	100	150,000
9	32	30,000	.....
9	36	15,919,500	8,390,000
9	40	4,190,000	3,420,000
10	30	500,000	.....
10	32	1,172,000	220,000
10	36	48,006,500	28,436,000
10	37	26,300,000	25,998,000
10	40	84,734,000	51,914,000
10	45	4,270,000	2,390,000
10	48	1,106,000	1,077,000
10	50	465,500	60,100
10	54	1,382,000	59,000
10	60	546,000	95,000
10	76	65,000	27,000
10½	36	770,000	204,000
10½	40	47,140,000	25,278,000
10½	45	150,000	100,000
11	40	50,000	92,000
11	45	489,700	260,000
11	48	768,900	335,500
11½	40	1,520,000	1,050,000
11½	48	606,900	314,000
12	36	13,319,700	6,936,000
12	40	11,294,000	8,036,000
12	45	50,000	.....
12	48	1,080,000	.....
14	31	50,500	.....
14	40	550,500	200,900
15	31	131,000	186,000

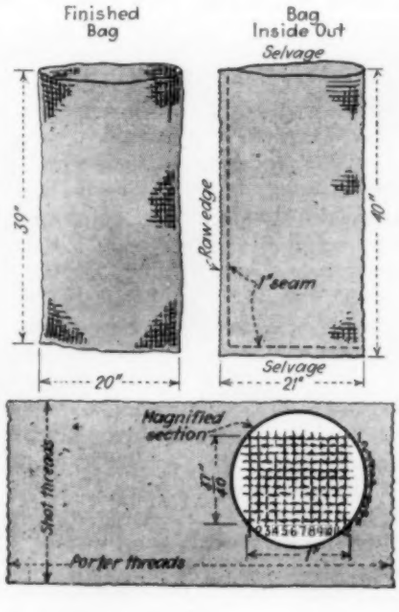
fibers; this process consists of combing and further mixing the fibers. The roving and spinning operations are mainly twisting, but there is some drawing (mixing). After more twisting, the fibers are changed to yarn and are ready for weaving.

The cloth is woven in a variety of constructions on regular automatic looms, such as single, plain weave known as hessian, bagging, tarpauling, sacking, etc. After the weaving operation there are several methods of finishing the cloth, the most important of which are:

1. Ordinary—Consists of removing all projecting fibers and of giving the cloth a finished appearance.

2. Double Calendered—The ordinary burlap is run through a five-roll calender, one roll of which is heated. The function of this is to flatten the round threads and thereby close the holes between the threads.

3. Chested or Mangled—These different operations perform the same function as double calendering to a greater degree as more pressure is applied and therefore the added flattening of the threads leaves fewer and smaller holes.



To one familiar with the manufacturing processes of cotton cloth it is evident that jute is treated in the same general way. The methods used, however, are cruder as the jute fiber does not lend itself to the same scientific handling as cotton. As a result jute cloth is not the uniform product that is obtained with cotton.

This is of passing interest only to the American bag consumer. The really important points are what standard constructions are available, what their comparative strengths are, and the best methods of closing filled bags.

The products of each burlap mill in India are constantly inspected and tested and each year one of the large bag companies with the cooperation of the other companies in the industry, issues a quality classification dividing all mills into A, B, C and D groups. There are separate classifications for mills making lightweight burlaps (up to 9 oz.) and heavyweight burlaps (9½ oz. and up). This grouping is also based on certain factors which are of interest only to the bag manufacturer—such as short yardage, wrinkled and folded ends, and the like, but in general can be used as a quality guide by the bag buyer.

It is important that in choosing a bag, the size be picked so cloth of standard construction can be used. It is also desirable to use a burlap which is imported in substantial quantities. For your guidance you will find a tabulation showing the imports of burlap, by constructions, from Calcutta for the 12 months of 1934 and the first six months of 1935.

There are no statistics available on imports from Dundee (Scotland) or from Europe (Continental burlap) but the purchases from these sources are not nearly as large as those from Calcutta. Burlap woven in Dundee and in some Continental mills is of high quality. Recently, however, some new Continental mills have been shipping inferior burlap to the United States. This cloth is usually sold at a discount, as it is ½ to 1 oz. light in weight which is extremely hard to detect. To guard against receiving these goods, the bag buyer should clearly specify on his purchase order the exact grade, weight, construction and origin of the cloth.

The most common method of converting cloth into bags is to cut the burlap so that the selvages of the cloth are at the mouth and the bottom of the bags, and the raw edges are at the side seam. Therefore, a bag measuring on the inside 20 in. in width and 39 in. in height "after made" is cut from cloth 40 in. in width. Each piece of cloth is cut 42 in. long. When doubled 2 in. of the length of the cloth is used in the side seam and 1 in. of the width is used in the bottom seam. This scheme can probably be better visualized by the accompanying illustration. It should be borne in mind that the width of 40 in. burlap varies from a little over 39 in. to 40½ in. so burlap bags are not uniform in size. Also, in the sewing it is possible for the seam to vary slightly. The user should take these factors into consideration when making a decision regarding bag sizes.

The weight of the burlap, the twist of the yarn and the manner of weaving are the chief elements in the strength of the cloth. Weights are controlled by varying the size and twist of the threads and by the number of threads woven in a given distance. All textiles are woven with varying numbers of threads running in two directions—namely, the direction of the length of the goods and the direction of the width of the material. Jute weavers use the word "porter" to describe the threads which run in the direction of the length of the goods and the word "shot" for the threads that run at right angles to the porter. A unit of measurement for the porter is 37/40 in., which is the diameter of an English shilling, and that for the shot is 1 in. The number of threads is called the "count" and therefore a count of 11 by 12 represents 11 threads per 37/40 in. in the porter and 12 threads per in. in the shot. An accompanying illustration and tabulation show the more important constructions and their approximate tensile strengths. When compared with the table showing the constructions in general use for carrying certain products these can be used as a ready reference in deciding on samples to be tested for new products or for replacing present bags. Cloth from several mills and, in fact, cloth from one mill made at different times will vary greatly in tensile strength and therefore the tensile strength classifications must be considered of interest only for comparisons of weights and constructions.

Double locked stitch

Needle twine above and looper twine below. Stitch used on Union special heavy duty sewing heads for making and closing bags

Before selecting construction of burlap to be used in bags it is necessary to consider the weight of material which will be packed in the container. This, of course, involves trade practice, customer's requirements, and the like. A package containing 100 lb. is the best size to choose, as it offers many advantages in handling and it will probably be easy to select a proper construction of burlap which will carry this weight with little or no loss. One man can handle 100 lb. bags more efficiently than heavier packages and this is an important consideration to all concerned.

Another important consideration in the choice of burlap is the physical characteristics of the product. For instance, a powdered material which will compress under stresses of handling tends to absorb shocks, whereas granular materials will transmit shocks to the bags.

Stresses and strains on burlap bags when dropped are exerted to a greater extent against those threads that run in the direction of the circumference of the bag, or the porter threads. When the bag is dropped in a horizontal position it will usually fail along the top of the flat side and on a butt drop the contents tend to increase the circumference, thus causing rupture of the same porter threads. It is therefore evident that the stronger the porter threads, the stronger are the bags.

There are some special burlaps that can be obtained which are of the extra count construction or are made with stronger porter threads. If these can be purchased they will make bags which are as strong as or stronger than bags made of heavier burlap of standard construction. These types of cloth are extremely hard to get, however, and they must be ordered in very large quantities, and three months or more before bags are needed to allow time for importation from Calcutta.

The bottom and side seams of the bags must be stronger than the bag material. The reason for this is obvious. Bag manufacturers generally use a double-locked stitch, which if the thread is broken will not unravel. The common practice is to sew bags with 3¼ to 4 stitches to the inch. The double-locked stitch is of such a construction that a heavier twine is used in the needle stitch than in the looper. A general rule is to have the strength of the needle twine 50 to 75 per cent greater than that of the looper twine. The following are some of the more popular threads used in making bags:

Type	Ft. per Lb.	Breaking Strength
10's/3 ply	8,400	5.25 lb.
10's/4 ply	6,300	7.75 lb.
12's/3 ply	10,100	4.30 lb.
12's/4 ply	7,500	6.25 lb.

Bags in Use for Shipping Commodities

Burlap

Weight of Burlap, Ounces	Cut Size Inches	Effective Bag Size Inches	Product Packed	Weight, Lb.
8 ord	36 cut 34 to 48	16 to 23 by 35	Salt	100
**8 ord	36 cut 42	20 by 35	Sugar	100
8 ord	40 cut 44 to 45	21½ to 22 by 39	Potatoes	100
8 ord	40 cut 50 to 52	24 to 25 by 39	Wheat	100
10 ord	40 cut 52	25 by 39	Mash feed	100
10 ord	40 cut 40 to 46	19 to 22 by 39	Fertilizer	125
10 ord	36 cut 42 to 47	20 to 22½ by 35	Fertilizer	125
10 D.C.	36 cut 42	20 by 35	Glaubers salts	100
10 ord	40 cut 46	22 by 39	Shelled peanuts	115
10½ ord	40 cut 45 to 46	21½ to 22 by 39	Scratch feed	100
10½ ord	40 cut 50	24 by 39	Flour	167
10½ ord	40 cut 44	21 by 39	Ammonium sulphate	100
10½ ord	40 cut 55 to 60	26½ to 29 by 39	Ammonium sulphate	200
*10½ C & M	40 cut 32 to 39	15 to 18½ by 39	Cement	94
10½ C & M	40 cut 57	27½ by 39	Cleaning compound	200
10½ ord	40 cut 52	25 by 39	Dextrine	140
10½ ord	40 cut 50	24 by 40	Fertilizer	167
11 ord	40 cut 58	28 by 40	Fertilizer	200
11 ord	36 cut 40	19 by 35	Sal Soda	100
11 ord	36 cut 40	19 by 35	Sulphur, agricultural	100
12 ord	40 cut 50	24 by 39	Flour	167
12 ord	40 cut 48	23 by 39	Sulphur, rubber	150
12 ord	40 cut 55 to 60	26½ to 29 by 39	Ammonium sulphate	200
12 ord	36 cut 44	21 by 35	Boric Acid	100
*12 C & M	40 cut 32 to 39	15 to 18½ by 39	Cement	94
12 D.C.	48 cut 53 to 56	25½ to 27 by 47	Glue	200–250
12 ord	40 cut 52	25 by 39	Salt	224
12 ord	48 cut 68	33 by 47	Soda ash	300
12 ord	45 cut 52	25 by 44	Soda ash	150
12 ord	45 cut 60	29 by 44	Soda ash	200

Cotton

Cloth	Cut Size, Inches	Effective Bag Size Inches	Product Packed	Weight Lb.
40 in.-7 oz. osnaburg	40 cut 56	27 by 39	Ammonium sulphate	200
*30 in.-7 oz. osnaburg	30 cut 35 to 38	16½ to 18 by 29	Cement	94
30 in.-7 oz. osnaburg Cal'd	30 cut 44	21 by 29	Copperas	100
40 in.-2.35 yd sheeting	40 cut 46 to 51	22 to 24½ by 39	Copperas	200
***36 in -6.15 yd sheeting	36 cut 49	23½ by 39	Epsom salts	100
36 in.-2.85 yd. sheeting	36 cut 42	20 by 35	Fertilizer	100
40-in.-2.50 yd. sheeting	40 cut 39	18½ by 39	Fertilizer	100

Note: Bag construction in all cases is regular.
* Designates returnable bag.
C & M—designates cropped and mangled.
ord.—designates ordinary.
Cal'd—designates calendered.
**—designates outer of double bag.
D.C.—designates double calendered.
***—designates inner of double bag.

The tensile strength of the sewing twine need not be equal to the strength of the burlap, as the stresses and strains of handling filled bags are transmitted to the cloth and to the seams of the containers in different ways. The best way to test the comparative strength of the twine and cloth is to make drop tests of filled bags. If the seams burst before the cloth is ruptured it is evident that heavier twine is required. The cost of the twine is so small in comparison with the cost of the fabric that it is poor economy to take any chances that the strength of the seams is not greater than the strength of the fabric.

The problem of closing filled bags should receive careful attention. There is not only the matter of labor cost to be considered but a well-planned closing operation may allow the use of smaller containers. If the volume of bag shipments is relatively large, the reduction of ½ in. or more on the width of the bag will result in a handsome yearly saving. There are three commonly used methods for bag closings:

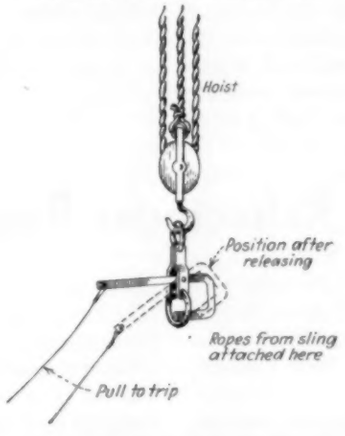
1. The best plan for volume production is to sew the bags. They pass from the filling spout on a horizontal conveyor to a sewing machine that is adjusted to the proper height. The bags are then guided by hand through the jaws of the machine and the thread is cut. Adjustments of conveyor and sewing machine must be accurately worked out in order to economize on bag size. There are some gadgets on the market that are designed to sew the bags within 1 or 2 in. of the edge, and in some instances they have worked successfully. The usual stitch used to close the bags is the double-locked stitch previously referred to. Regular practice is to use four stitches per inch, but if the material to be packed is finely powdered, some machines can be adjusted to sew as many as five stitches in every inch, which is more satisfactory.

Tests have indicated that it requires 464 yd., or 0.2303 lb., of 12s/5 ply thread in the needle and looper of a sewing head to close 100 bags which measure 19 in. in width. This can be used for estimating bag closing twine costs.

2. Many manufacturers use the hand-sewed method, This is done by rolling down the mouth of the bag, forming ears at the end and then hand sewing. A large cooper's needle is used with jute twine and the sewing is usually a looping stitch over the rolled bag mouth. The labor and thread cost of this method of closing is greater than the cost of machine sewing, but this is sometimes offset by the ability to use slightly smaller bags.

3. The third method of bag closing is to gather the mouth of the bag, twist it slightly and tie with wire. This is a piece of malleable wire looped at both ends and is applied by twisting with a hand twisting tool. The method is more expensive than either of the other two, as it requires more time to effect a tight closure and larger bags must be used.

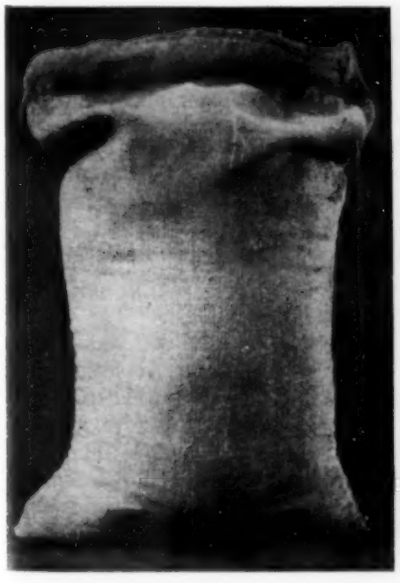
Tripping devise for drop tests



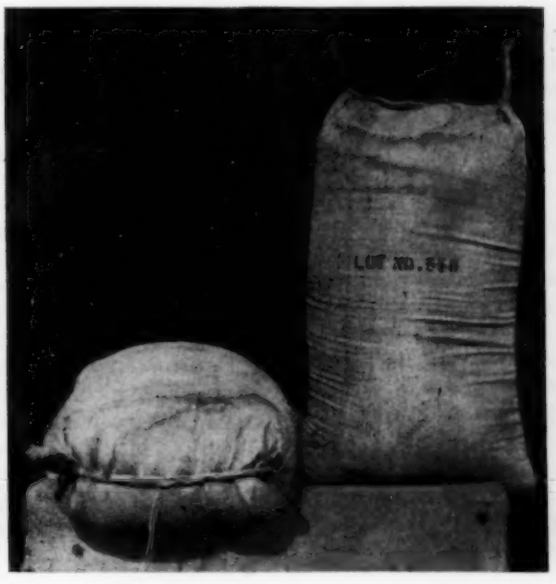
One of the most important considerations in closing bags is the amount of spill room to be allowed, and this is often neglected. A bag is not able properly to resist severe drops or shocks unless there is some space for the load to shift. This is one of the bad features of the hand method of sewing, as it is likely that the bag cooper will not allow sufficient spill room. As a general rule there should be a minimum of ½ in. and preferably 1 to 2 in. from the level of the contents to the closure. This measurement should be taken with the bag standing on its butt and both walls of the bag brought to-

Three commonly used methods for bag closures

Machine sewed



Hand sewed



Wire tied

gether, pressing on the top of the contents. The closure should then be ½ in. above the point where the center of the walls of the bag meet and contact with the contents. More spill room should be allowed in 150-lb. and 200-lb. bags than in 100-lb. and smaller bags, as the stresses and strains will be greater in the larger packages.

The only other tests which are apt to be necessary are those which determine whether the bags are sufficiently rugged to resist transportation and handling abuses and closely woven enough to prevent excessive sifting. Preliminary tests should be made in the factory, but it should be borne in mind that factory tests are only indicative—never conclusive. The only sure proof of a satisfactory package is to make several shipping tests, submitting the packages to actual handling conditions and transportation hazards.

The factory test for ruggedness or strength should be in the form of a drop test. It is recommended that standard drop tests be decided upon, such as a certain number of flat drops (landing on face of bag) from a height of from 4 to 10 ft., depending upon the service that the bag must withstand. This, combined with a standard number of butt drops (landing on bottom of bag) from a height of 2 to 5 ft., will give an accurate indication of the performance of the bags.

Drop testing by hand is not as accurate as dropping by apparatus as all drops cannot be conducted exactly alike. A bag dropping table has been developed which is adjustable to several heights. This device consists of two hinged doors which when released fall inward dropping the bag. Another good scheme is to use a hoist to which has been fitted a tripping device. The bag is placed in a rope sling and the ends of the sling are looped in the tripping device. When the bag is released the sling drops with it. Either of these methods should give accurate results if five bags of each type and size are tested.

An accurate and easy method of testing loss of contents through sifting is to weigh filled bags before and after drop tests. At least five to ten drops from a height of 4 ft. or more should suffice to give conclusive proof.

Bag printing is necessarily crude, due to the uneven surface of the cloth and the fact that this requires rubber printing plates. The best practice is to use one or two colors to print a design which is comparatively simple and one where a good deal of leeway is allowed for registration. However, there are some four color presses in use and some extremely involved printing designs are used with good results.

The bag user must not lose sight of the fact that the better the bag the higher the cost and the lower the transit damage. All transit damage cannot be eliminated except at prohibitive cost. A point of economic balance must be determined. This will depend, among other things, upon the chemical and physical characteristics and value of the product. And thus ends the story of a homely and commonplace package, which for all-around effectiveness in the world of commerce would be exceedingly hard to replace.

Trends in Refractories Requirements

FIVE PAPERS dealing with present problems and trends in refractory requirements were presented at the first summer meeting of the Refractories Division of the American Ceramic Society held at State College, Pa., September 20 and 21.

Notes on refractories for the electrothermic zinc industry was the subject of a paper by W. B. McBride, St. Joseph Lead Co., Josephtown, Pa. The furnaces now in use for the electrothermic smelting of zinc at the Josephtown smelter were described, and the type of charge used and the slag encountered discussed. The refractory problems and the difficulties met with commercial brick were enumerated. A low alumina refractory having low porosity was found to give the best service to these furnaces. Various types of refractories were tried.

Some observations on the behavior of refractories in glass manufacture were described by G. V. McCauley, Corning Glass Works, Corning, N. Y. The behavior of refractories in the manufacture of glass depends largely on the physical properties of both refractory and of glass, in addition to the chemical factors involved. Of the physical properties belonging to the refractory, the character of its bond which holds its particles together and the degree of its porosity are of major consequence.

Experiences in the use of refractories in the steel plant was the subject of a paper by Louis A. Smith, Jones & Laughlin Steel Co., Woodlawn, Pa. This paper concerned various phases of refractories used in the steel plant, such as checker brick, insulation, high-temperature cements, and tests. Suggestions regarding the improvements of products which are presented to the user were discussed. These include control of warpage and size of fire brick, standardization of shapes, furnace designs, and methods by which refractories are made.

Refractory problems in basic alloy steel production were discussed by Gilbert Soler, manager of research, The Timken Steel & Tube Co., Canton, Ohio. Following a discussion of the relation which should exist between the steel producer and the manufacturer of refractories in the development of refractories which meet the specialized needs of the producer, this paper outlined the various purposes for which refractories are used in a modern alloy steel plant. The relation between steel quality and refractory cost was developed, coordinating the refractory problems with service conditions which arise in the steel plant.

A discussion of the action of coal-ash slags on fireclay refractories was presented by Harold E. Simpson, Battelle Memorial Institute, Columbus Ohio. The action of coal-ash slags on fireclay refractories was studied by microscopic examination of thin sections prepared from quenched samples of ash and refractory heated together. The refractories used varied as to types of clays, method of fabrication, grind, and firing treatment. The coal ashes used varied from highly corrosive to non-corrosive ashes. The temperatures at which the refractories disintegrate, due to the slagging action of the coal ash, were given.

T.A.P.P.I. Convenes At Atlantic City

EDITORIAL STAFF REPORT

OVER 400 members and guests of the Technical Association of the Pulp and Paper Industry gathered at Philadelphia and Atlantic City on September 18 to 21 for the semi-annual meeting of the Association. A special feature of the convention was the visit to the laboratories of the Hercules Powder Co., near Wilmington, Del. R. H. Dunham, president of Hercules, and W. J. Lawrence, president of Paper Makers Chemical Corp., welcomed the visitors, who then inspected the laboratories and were served luncheon.

One of the luncheon speakers during the convention was H. P. Carruth, president of Dill & Collins, Inc. He gave the group his opinion, as a paper mill executive, of the place of the technical man in the pulp and paper industry. For many years this industry has been in a transition state as it has evolved from an art toward a science. Nearly every phase of the industry and all departments of the plant have been affected by this trend, which has been accelerated by conditions during and following the N.R.A.

Technology in the industry was first given recognition in the fields of civil, mechanical and power house engineering, which was staffed by men trained outside the industry. Later raw material testing created a place for the chemist. As time went on both chemical engineer and chemist penetrated more and more into the industry, particularly in the fields of equipment and processes for the operating department. Most recently the engineer has begun to be a figure of importance in the merchandising side of the industry.

Another point the speaker made was that there is a good reason why the engineer should avail himself of every chance to learn all sides and angles of the business in which he is engaged. Science as applied to industry is a tool to be used by the industry in the achievement of its objective, which is the making of profits. In consequence, since the value of engineers lies in their use of science in the production of profits, rather than of knowledge, it therefore follows that the engineer who can best adjust his efforts and knowledge to the profitable advancement of his company, will receive the greatest advancement and reward. To achieve this, an understanding of the aims, limitations, trends and generally all of the influencing factors in his business, is most helpful and is in fact essential. Too often the engineer devotes his thought and effort to some activity which has captured his personal interest rather than to one which is of genuine financial interest to his firm. Such a man may make a name for himself in scientific circles, may be acclaimed in the technical press, and even be the recipient of medals, but he will seldom be found advancing on the payroll or organization chart of his company. Engineers have been known who never seemed able to understand why this was true and who felt that they were unappreciated.

Pres. Clark C. Heritage flanked by Vice-Pres. G. N. Collins and Sec. R. G. Macdonald

Charles W. Boyce, executive secretary of the American Paper and Pulp Association, was the principal speaker at the luncheon on Saturday. He discussed the importance of forest operation to pulp production, and the trends that may be expected, especially as these may be influenced by Southern and Northwestern developments. Boyce stated that gradually pulpwood is coming back as a subject of discussion for conservation is becoming more important. The share of the industry in conservation is large.

We do know that pulpwood prices have hit a bottom; they apparently reached their low levels when paper prices appeared to be about to fall to zero in the winter of 1932-33. Since then there have been increases in all regions. The relation of these increases seems to the speaker to dictate the broad outline of the future pattern.

The fact that the industry in flowing to the South and to the West has expanded in these regions to dominating positions, means, he believes, that conditions in these regions will determine future pulpwood prices in all regions. The competition of these new regions in the paper market must eventually result in the weeding out of high-cost pulp mills in the older regions, thus reducing demand to a ratio similar to that in the new regions.

The group of papers presented at the several technical sessions were of unusually high quality. Hourly wage rates and their relation to minimum hourly rates in the paper and pulp industry were discussed by John P. Hagenauer of the American Paper and Pulp Association; the morphology of the cellulose fiber by G. J. Ritter of the Forest Products Laboratory; colloidal aspects of cellulose fiber by Ben Rowland of the Institute of Paper Chemistry; pulping treatment and fiber properties by George A. Richter of the Brown Co.; the mechanical treatment of fibers as affecting sheet structure by R. H. Doughty of the Fitchburg Paper Co.; principles governing arrangement of fibers on the fourdrinier wire by A. M. Lund of Mazer Products Co.; formation of cellulose membranes by Wanda K. Farr of the U. S. Department of Agriculture; effects of the principal variables on the rate of air drying, and the mechanism of drying of pulp sheets by heated surfaces by D. W. McGready of the department of chemical engineering, University of Michigan; tolerance in white water losses by C. M. Baker of the American Paper and Pulp Association; color analysis and specification by Joseph Razek of the University of Pennsylvania; effect of temperature and consistency in mechanical pulping by E. R. Schafer and J. C. Pew of the Forest Products Laboratory; testing methods of evaluation of unbleached chemical pulp by D. Johansson; factors affecting retention by W. R. Willets of the National Lead Co.

Considerations in Developing a Mineral Wool Industry

By CHARLES F. FRYLING and ORVAL WHITE

Respectively, Chemist, Non-Fuels Division, Illinois State Geological Survey, Urbana, Ill., and President, Mineral Insulation Co., Chicago Ridge, Ill.

MINERAL WOOL is a light-weight material composed of thin, glassy fibers. The raw material from which it is produced consists either of sedimentary rocks, which appear to be mixtures of shale and limestone laid down simultaneously, or of various types of metallurgical slag. In order to secure a material which can be melted and blown into wool, it is necessary that its acidic and basic constituents be fairly evenly balanced.

Chemically, rock wool, which can be defined as mineral wool obtained from naturally occurring rocks, consists of silica, alumina, lime, and magnesia in combination. The composition limits have been determined experimentally. (See Illinois State Geological Survey Bulletin No. 61, "Rock Wool From Illinois Mineral Resources," Urbana, Ill., 1934.) One important point revealed by this study is that the properties of rock wool are definitely determined by composition and blowing conditions. Therefore, provided the composition is correct, it is immaterial whether the wool is produced from a single rock, a mixture of rocks, or from some other material, such as slag. Slag wool and rock wool of the same chemical composition, and blown under the same conditions, would be indistinguishable. However, it must be remembered that many slag wools are produced having compositions which are quite different from those yielded by rocks, and the differences in the products may be quite marked.

The most important use for mineral wool is as a heat insulating material. The tangled mass of fibers of which the material is composed serves to entrap a large number of small air pockets which, in turn, impart the property of low heat conductivity to the aggregate.

Mineral wool has many advantages compared with other heat insulating materials. Among these may be mentioned:

1. On the basis of its coefficient of heat transfer, mineral wool ranks among the best commonly available heat insulating materials (*loc. cit.*, pp. 237-39).

2. Deterioration is practically nil. It is quite usual to find it unimpaired after 25 years or more of service.

3. In contrast with certain organic materials, it is inert toward moisture and, consequently, its insulating properties show less tendency to fluctuate with changing weather conditions.

4. It is thoroughly fireproof and verminproof. This should be of importance from the standpoints of health and insurance rates.

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Fig. 1—Rock wool cupola during construction

5. It can be fabricated in forms convenient for use in the building industry, such as loose fill, rigid board, and quilts.

6. It is an excellent acoustical insulation material. In this connection, it is interesting to recall that it was used to insulate the broadcasting studios of Radio City.

7. It is relatively inexpensive and the indications are that it can be produced more cheaply than it is at present.

Although it finds considerable use in industry, there is much to indicate that mineral wool will find its widest application in the insulation of buildings. It can be expected to contribute towards better health by equalization of room temperatures, elimination of drafts, increased comfort in both summer and winter, and reduction of vermin and fire hazards. That it contributes materially towards the economical use of fuels is well known. A

recent article in the *Sheet Metal Worker* (**26,** Jan., 1935, 41, 2) gives the calculated heat losses through 1,000 sq.ft. of wall. The wall consisted of clapboard on sheathing with building paper between, 2x4-in. studs set at 16-in. intervals, and an inner wall of wire lath and plaster. The calculation was made for a 15-mile per hour wind velocity, 200-day heating season, 30-deg. average temperature difference, and 24-hour load, with the following results:

	Heat Loss, B.t.u	Equivalent* Tons Coal
No insulation	38,000,000	1.6
1 in. of rock wool.....	18,700,000	0.8
3⅜ in. of rock wool ...	8,600,000	0.4

*Coal equivalence was calculated by the present authors on the basis of 12,000 B.t.u. per lb. of coal.

Fig. 2—First rock wool plant, Alexandria, Ind., 1897 (Courtesy Mr. C. C. Hall)

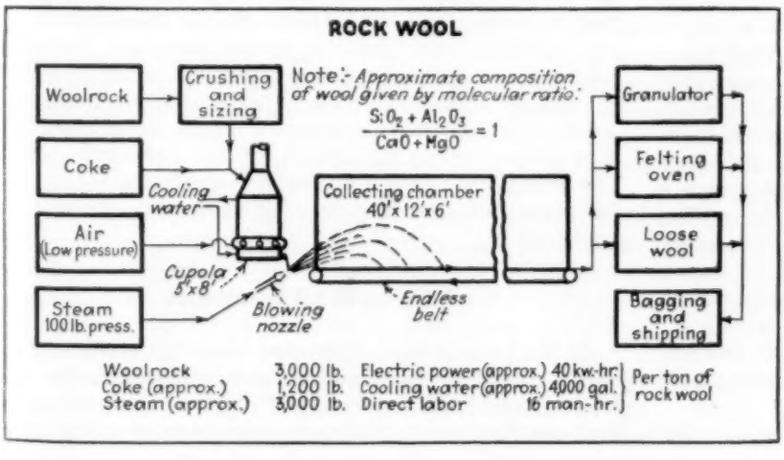
Manufacturing Process

Production of mineral wool from slag has been practiced for about 60 years. The most important improvements, however, were made about 35 years ago by C. C. Hall, who established a plant for the production of rock wool at Alexandria, Ind. Incidentally, the rock wool industry was born during the depression of 1896. Mr. Hall, who had been operating a steel mill at Alexandria, tried local stone to find a less expensive fluxing agent. He found that the slag produced by the local stone readily blew into fibers when struck by the air blast of the smelter. He experimented further to satisfy his curiosity. After the steel mill had been closed, he investigated the possibility of using cheap natural gas, then available, to make fireproof insulation out of the self-fluxing stone that he had discovered. He erected his first plant without further experimentation. The picture (Fig. 2) shows Mr. Hall, the first plant, the first carload of mineral wool shipped from Alexandria, and the first men employed in the rock wool industry. The first melting equipment is also visible. This was simply a brick puddling furnace employing natural gas fuel. It was constantly giving trouble because of refractory corrosion. Under these inauspicious conditions, the rock wool industry started. To Mr. Hall, the industry owes a tribute for 30 years of hard work put forth in its behalf.

Present-day practice follows very closely that finally established by Mr. Hall. Cupolas about 5 ft. in diameter and 8 ft. high are used, as in Fig. 1. A mixture of rock, or slag, and coke, is fed into the top of the cupola, and molten material flows out at the bottom in a steady stream. Combustion is supported by a blast of air fed into the bottom of the cupola. A temperature of about 1,500 deg. C. is attained and cooling is effected by a water jacket. A steam blast, issuing from a trough-shaped nozzle at a pressure of about 100 lb. per square inch, is directed at approximately a right angle to the stream of flowing material. This is broken up into innumerable small droplets which are propelled into a collecting chamber. During its flight through the air, each little droplet drags out a small thread of material which solidifies before falling.

Cupola capacity is rated at 1,000 lb. of wool per hour, but 500 lb. per hour has been considered satisfactory. The raw material must not be so fine that it blows out of the cupola or plugs it up. It is considered advisable to use an assortment of definitely sized materials in order to prevent excessive channeling within the cupola. The object of the melting operation is to secure a steady stream of molten material of homogeneous chemical composition of the proper blowing temperature.

Fig. 3—Simplified flow diagram of a rock wool plant



Wool may be collected on an endless belt in a chamber about 6 ft. wide and 40 ft. long. A small quantity of oil is usually added to the steam used for blowing in order to reduce dust, to secure better cohesion and to produce a more water-resistant product.

The crude wool may be fabricated into any of the various forms required by the trade. It can be treated in special equipment in order to produce a refined product for blowing between walls, it can be loosely compressed into blankets, inserted into ready-built forms, sewed up between paper or wire netting to form quilts, or fabricated into plasters, bricks, and other forms. One difficulty encountered in fabricating mineral wool is slow drying, a consequence of its low heat conductivity. For this reason, it is essential to keep the wool fairly dry during the blowing process.

Improvements Possible With Present Equipment

It seems probable that most mineral wool plants now in operation are antiquated. Chief difficulties encountered are high and variable fuel consumption, wide variation in quality of product and inability to maintain continuous operation.

These difficulties can be largely attributed to the empirical nature of the present manufacturing procedure. Little effort to establish control of the raw materials has been attempted. Rocks which are assumed to be of the proper composition are used and temperature is controlled according to the whim of the operator. It is, therefore, desirable to provide some degree of chemical control. Methods similar to those used in the cement industry would be ideal, but the possibility of introducing such complete control at the present time appears to be too great an advance to bring about immediately. It is suggested, therefore, that a carbon dioxide determination might be used to advantage (*loc. cit.*, Bull. 61, pp. 225-29). The weight of carbon dioxide in naturally occurring rocks is a fairly accurate measure of the basicity of the melt. The data would be used to proportion the charge so that its average carbon dioxide content would be some specified value, say, 28 per cent. It is evident that this method can only be applied as a control in the production of wool from rock, for it is not applicable in the case of wool from slag.

It is possible to suggest certain ways in which the efficiency of the present type of equipment might be improved; but before these are undertaken, an accurate heat balance for the process should be secured. Apparently, the cupolas have not been designed with an eye to heat economy, for the rock can be melted much faster than it can be blown. It would not seem impossible, however, to blow two or three streams simultaneously from the same cupola. At the same time, the possibility of reclaiming waste heat from the cupola and stack should not be overlooked. A somewhat similar case is that of the U.G.I. producer gas generator, which utilizes a water cooler for the generation of steam. The possibility of effecting a similar economy with the cupola should be subject to a thorough investigation by a competent engineer.

A means of following the temperature of the slag stream should be provided. Adequate equipment should be provided to eliminate operating hazards.

It is quite evident that present methods are rather limited in regard to the range of compositions which can be employed, the type and size of raw material, and the extent to which mixtures of raw materials can be accommodated. A method allowing the use of mixtures, say of limestone and shale, would enjoy the following advantages: (1) It would be possible to produce a product of predetermined composition. (2) The location of the plant would be independent of the occurrence of woolrocks and could be decided entirely on economic considerations.

Some industrial attempts have been made to produce mineral wool by admixture of silica sandstone and limestone. (See Thoenen, J. R., "Mineral Wool," Inf. Circ. No. 6142, U.S. Dept. of Commerce, Bur. of Mines, June, 1929.) The literature does not indicate what success has attended these efforts.

We wish to suggest pre-sintering of pulverized raw materials in a rotary kiln as a suitable method for production of clinker of controlled composition for subsequent melting in a cupola. Mineral wool could then be made from suitable mixtures of such materials as homogeneous or nonhomogeneous woolrocks, sandstone, shale, sub-woolrocks, slag, cinders, cement rock, clay, sand, gravel, loess, till, limestone, dolomite and oyster shells.

On the basis of data presented before Congressional hearings on the tariff (Schedule 15, 1929) regarding the cost of portland cement production, the senior author has estimated that the cost of grinding, mixing, and pre-sintering should be from $1.50 to $2.50 per ton of clinkered material. This added cost should be offset, in part or in toto, by the following economies in operation:

1. Fluctuations in cupola output would be reduced.
2. Fuel consumption for the cupola operation would be decreased.
3. The cheapest raw material available at any given time, from the list just presented, could be used.
4. "Mineral wool cullet" could be used over by putting it through the sintering process. It would constitute the very cheapest form of raw material possible. (Note: In the production of granulated wool and other finished products, there is a large loss due to sifting out of shot, large fibers and other coarse material. At present, this loss may amount to 50 per cent by weight of the wool produced.)

These possibilities for improvement in the production of rock wool indicate that the cost of production can be materially decreased.

Finally, unless one has had actual operating experience and is thoroughly familiar with the process, it would be rash to build a full-sized plant. In the development of any industry from research, several steps are desirable before the process can begin profitably to produce for the market. A small scale plant should be built and operated successfully in order to obtain the engineering data necessary for the design of the full scale plant. The nucleus of a sales force must evaluate the product of the plant and determine in what manner it can best be marketed.

Mineral Wool Economics

At the present time, there are about 30 producers of mineral wool in the United States. This includes the producers of both slag wool and rock wool, as well as at least one firm which produces a mineral wool using soda-

lime glass as the raw material. It is apparent that the number of producers is increasing. There are three or four plants operating in the vicinity of Los Angeles, eight in Indiana, and plants are either in operation or are being established in Illinois, Texas, Ohio, New Jersey, and Vermont.

For many years the industry was largely centered around Alexandria, Ind., but the general trend at present seems to be toward decentralization in order to supply local needs more economically. The factors which favor this decentralization, as well as those which are temporarily hindering it, are significant.

The large volume of a ton of mineral wool limits the quantity of material that can be loaded into a box car. The bulk density of the material is about 10 lb. per cubic foot, and only about 12 tons can be loaded per car.

Table I—Freight Rates on Mineral Wool From Alexandria, Ind., to Various Points

Chicago	$4.80	Kansas City	$10.40
Cleveland	5.80	Minneapolis	11.20
St. Louis	6.00	Birmingham	15.00
Baltimore	9.00	New Orleans	19.40
Philadelphia	9.40	San Francisco	52.80
New York	10.00		

Therefore, the freight rate is high. The freight rate on rock wool from Alexandria to various points is as shown in Table I.

Another factor favoring decentralization of the industry has been the discovery of woolrocks in various places. Within the past four years, the discovery of woolrocks has been recorded in geological reports from Illinois, southern Indiana, and Ontario. Developments are now under way which indicate that pre-mixture of limestone and shale is feasible. If successful, this will make the industry independent of the location of woolrock deposits which, in turn, will tend to accelerate the decentralization process.

There are several factors, however, which have retarded rapid decentralization of the rock wool industry. Among these has been the Rock and Slag Wool Code. While the code was in effect, a uniform retail price of about $50 per ton was maintained throughout the United States for mineral wool in bulk, and the price of the material refined for blowing into houses was approximately $70. This uniform price made it difficult to start up in a new locality and secure the bulk of the local market by lowering prices an amount equal to the freight differential.

The patent situation is also a factor in delaying complete decentralization. Six of the larger producers are reported to control the patents for blowing refined rock wool into the walls of dwellings which have already been built. This makes it difficult for newcomers to break into what may be the most lucrative phase of the house insulation business.

Increased use of automobile trucking has helped the industry to overcome, to some extent, the unfavorable freight rates, thus delaying the necessity for decentralization. Since only one handling is involved, paper bags in place of burlap bags can be used, resulting in a difference in cost of about $6 per ton.

Tardy recognition of the value of insulation in homes has been a serious drawback to the industry. It has taken the public some years to discover the merits of the various types of insulation available. Mineral wool has no structural properties; it is used solely for its heat-retarding qualities. At the present time, mineral wool for house insulation meets practically no sales resistance and it is possible to look forward with confidence to a widespread increase in its use.

Other important considerations for the prospective producer of mineral wool are the following: probable market, plant cost, production cost, and fuel cost. In the discussion of these, it should be realized that accurate figures can be obtained only from complete cost data. Furthermore, it must be remembered that such figures will vary from plant to plant, and from time to time. Nevertheless, with these limitations, we think that the estimates which we are able to present in the table below will be of value.

Probable Market—In 1931, *American Builder and Building Age* published a series of articles attempting to evaluate the future market for insulating materials. The material for these articles was collected from the building industries by the publication. On the basis of the number of buildings which could be profitably modernized, and the probable new construction, it was estimated that there was an annual market for 11,700,000,000 sq.ft. of insulating materials. At the time, it was thought that mineral wool could capture at least 50 per cent of this market, and it was estimated that the probable future market for mineral wool could be placed at $100,000,000 per year.

Now that the economic trend seems to be upward, it is interesting to re-examine these figures. Apparently mineral wool has captured at least half, if not more, of the building insulation business. Subsequent to 1933, the mineral wool business has witnessed renewed activity, and has expanded beyond its predepression high. It is believed that $3,000,000 is a conservative estimate of the present annual business; and, considering the delayed housing construction, it does not seem unwarranted to expect the $100,000,000 per annum figure to be attained within a few years.

Cost of Plant—The estimate of Table II is based on the use of new materials. The capacity of the plant is rated at 1,000 lb. of mineral wool per hour. Again, it should be remembered that local conditions may affect the cost one way or the other from the figures presented. An operating plant with quarry and land should, therefore, cost from $50,000 to $75,000. This makes no allowance for pilot-plant development, or the development of an adequate sales organization.

Table II—Estimated Cost of a Two-Cupola Rock Wool Plant

Cupolas (two)	$1,500
Blowers	1,400
Steam boiler, pipes, valves, stack	3,000
Collecting belts (two)	1,600
Shredding machinery	500
Dryer, wool compressor, etc.	5,000
Building materials	10,000
Labor	8,000
Power and water	1,000
Miscellaneous	6,000
Total	$38,000

Fuel and Production Costs—The cost of fuel will vary with the location. It is reported that coke is obtainable in the Chicago area at from $4 to $5 per ton. Somewhat less than 1 ton of coke is required per ton of wool produced. With the present type of equipment, it should be possible to produce wool at a figure under $20 per ton, figuring all costs.

How to Use Pilot Plants in Process Development

By F. C. VILBRANDT
Head, Department of Chemical Engineering
Virginia Polytechnic Institute
Blacksburg, Va.

PILOT PLANT operation is a phase of engineering experimentation introduced into the development of American chemical industry with the rise of the chemical engineering profession in this country, 25 years ago. It was primarily through the efforts of chemical engineers that this scientific method of attack was adopted into industrial development practice.

What constitutes a pilot plant, or pilot plant operation, depends primarily upon the point of view one wishes to take regarding development practice. It may be that phase of development embracing all the stages between the laboratory and the commercial unit, or it may be that phase dealing only with the last stage before erection and completion of the commercial unit. After the laboratory stage, the exact division of the engineering experimental transition period is essentially a matter of choice, but it is quite possible to subdivide the effort into as many stages as the nature of the product may demand, if personnel, equipment and housing facilities permit. A possible subdivision of engineering experimentation may be indicated as: (1) small batch unit (approximately 10-lb. batches); (2) large-batch or unit-process stage (approximately 100- to 200-lb. batches); and (3) large-scale model unit, which may be further subdivided into a semi-works unit to be used as an experimental plant, and a large-scale semi-commercial unit, to be used for initial production, or available for both purposes, to be temporary or permanent, as the occasion may demand. The second and third of these stages are essentially parts of the pilot plant.

The small-batch plant should be quite simple and flexible enough to meet a wide variety of conditions requiring investigation in determining certain phases of operation prior to the expenditure of larger sums of money. In the large-batch stage, the plant space should be large enough to permit manufacture of a sufficient quantity of product to enable the experimenter to determine its quality, to permit the use of commercial materials and to ascertain the effects of impurities on the success of the process. Flexibility in design is again desirable. The layout for this stage should consist of units large enough to give information on variations in the proportions and conditions of operation, without consuming large quantities of material. In such a unit no attempt should be made to obtain all costs of operation, or to operate upon an efficient manufacturing basis, or to arrange the apparatus in the proper flow relation.

Where the process conforms to past experience, the stage described may be sufficient to lead directly to a commercial installation. If not, the pilot plant stage must follow for determining such factors as: cost of operation, proper methods of transportation around the plant, the optimum balance between production capabilities of the various pieces of equipment, flow relations, industrial hazards, possibilities of creating a public nuisance, reclamation of valuable byproducts, and the disposal of large tonnages of waste. The pilot plant must solve problems concerning materials of construction, incidental speeds of reaction, time, temperature, heat transfer and other items that have escaped previous observation. Its product is salable and the unit can serve as the source of supply for consumer testing. Even after the commercial plant is erected, the pilot plant should remain available for some time for the study of possible changes in the process, without costly interference with production in the commercial unit.

In the abstract, it appears to be impossible to set down all of the requirements of a pilot plant. The varied nature of the requirements defies formulation. In a small plant one man may have many functions, while in a large one the need for specialization becomes more apparent. Furthermore, one cannot operate an experimental plant for any great length of time under a rigid, inflexible arrangement, for it is usually necessary to shift the line-up continually to care for the changing conditions of the project. As an example of some of the unpredictable variations that may be encountered, it may be well briefly to recount the history of one actual project development.

Case History of a Process Development

An independent oil company had available considerable quantities of commercial butane for which there existed only a limited and relatively unprofitable market. Needing an outlet, the company considered the possible conversion of this butane into commercial chemicals, such as alcohols, aldehydes or acids. A research chemist, not connected with the company, hearing of the problem, presented a scheme based on the partial oxidation of butane to alcohols, aldehydes and acids, and this scheme sounded sufficiently attractive to cause the company to engage a consultant.

The consultant, a chemical engineer, was skeptical of the process and requested a systematic literature search. The search revealed many investigations and patents which, however, differed from the proposed simpler

Condensed from a paper presented by the author under the title of "The Place of the Pilot Plant in Process Development," presented before the American Institute of Chemical Engineers, Wilmington, Del., May, 1935.

process for the conversion of butane. As cost data, yields and other important information were lacking, the consultant advised setting up a research laboratory manned by the originator of the process as assistant, together with one chemical engineer development man and an analyst.

The first step was to construct a small-batch unit in which the smallest size commercially available compressor was used as the basis for calculating the other equipment to be purchased or to be made. Only equipment on the open market or easily made in the shops was considered. Based on the originator's data, the small unit was designed to process 100 cu.ft. of butane per day, yielding 2 gal. of product. Equipment included three household gas meters, a 3x1½x3-in. two-stage compressor, a ¼-in. coil reaction furnace and a 2½x3-in. single-stage gas booster. This unit with accessories, piping, reservoirs, storage containers, and so on, was set up in a research laboratory provided with the usual services. Installed cost amounted to $1,250.

Progress From Stage to Stage

Factors studied in this equipment included the effect of temperature, pressure, ratios of reacting gases, degree of dilution, velocities of gases through the reaction zone, thermal requirements, yields, and composition of the products. Sufficient data were obtained to show the optimum conditions for producing the maximum yield of marketable products. Product analyses quite different from those claimed by the originator resulted. The product was a mixture, indicating that a new problem of chemical or physical refining must be solved to produce a marketable commodity. To obtain sufficient product for rectification studies, a large-scale set-up was found to be essential, both for this purpose and for a better check-up on unit processing.

Consequently, a unit, five times the size of the laboratory unit, was designed and erected in the field where the supply of butane was large, where second-hand equipment was available, and where rectification could be carried on out-of-doors. The new equipment included a three-stage compressor, 3x1¼x⅞x3½ in.; a rectangular furnace using 1-in. tubes; a 12-ft. long multi-tubular condenser with ten 2-in. tubes and a second condenser containing 5 ft. of 1-in. tubing; a gas-engine-powered recirculating engine. Employing one additional engineer and a field operator this unit confirmed the operating conditions of the research laboratory and was successful in producing material for the rectification investigation.

This latter study was carried out on a small-scale unit, employing a 20-gal. still kettle, a 12-ft. x 6-in. rectifying tower, and a causticizing treatment to aid in final purification. The rectification problem was found to be more difficult than had been anticipated and was taken back into the research laboratory where considerable study was required before the process was again carried on in the small-scale unit.

In the stages of the study outlined above the data obtained indicated that the process was commercially feasible and showed promise of excellent returns. Consequently, design of a pilot plant was undertaken. This plant, calculated for 32,000 cu.ft. of butane per day, was designed for outdoor erection with large-scale compressor and recirculation units, full-scale commercial condensers and a specially designed multi-tubular furnace. The cost of erection was approximately $15,000. This plant was placed under two chemical engineer operators, an analyst and several oilfield operators, while the originator of the process and the consultant maintained continuous contact with the operations.

Concurrently with the operation of the new semi-commercial plant, the research chemical engineer, an analyst and a chemical engineer operator went to work in the research laboratory, answering questions which began to come in from the semi-commercial plant. Many operating points which had previously been overlooked or had not been apparent began to indicate potential difficulties in the offing. The furnace control had to be revised to maintain variations within closer limits, a new condenser design became necessary, a change in the method of transportation of process materials and the modification of recirculation design were required. Other changes were in rectification equipment treatment and in the design of the fractionating column. A new problem of slow resinification of one of the products which deposited in the condenser tubes made itself evident, requiring renewed study in the research laboratory. Complete operating costs now became available and a better flow relation was obtained. A public nuisance hazard was unearthed, indicating that it would be a major factor in the location of the final commercial unit. The job of reclaiming valuable byproducts was sent back to the research laboratory.

Thus the process was carried almost to the point of a successful commercial conclusion. Had it not been for the loss, at this point, of the market for one of the products, making the margin of profit too small for successful operation, the final process would easily have avoided patent interferences and would have operated as a commercial success.

Solid Carbon Dioxide for Tank Welding

According to a communication from a member of the National Safety Council, which appeared in the September issue of the Chemical Section's *News Letter,* solid carbon dioxide recently solved a hazardous welding problem. A group of steel tanks, about 10 ft. high by 10 ft. in diameter, had been used for the storage of methanol and other solvents. These rested originally on the ground but were later surrounded by retaining walls and buried in dirt and sand as a safety measure. Soon after the tanks were buried one of them developed a leak in an old 2-in. screw plug in the center of the bottom, but this was not discovered until several hundred gallons of the solvent had leaked into the fresh dirt fill.

The tank was emptied, thoroughly cleaned and ventilated and the atmosphere tested with a combustible gas indicator. Even after these precautions, however, there was danger of explosive solvent in the earth outside the leak. To avoid this hazard solid carbon dioxide was packed around the leak, forming a cake about 3 in. thick and 1 ft. in diameter. A steel cap 14 in. in diameter and 3 in. deep was then placed over the solid CO_2 and welded at its edge to the bottom of the tank, using an electric arc. The CO_2 rendered the atmosphere around the leak inert and prevented any flammable vapors from coming up through the hole while the welding was in progress.

Electrochemical Developments

High-Temperature reactions, batteries, electro-organic chemistry and electrodeposition activities composed the principal topics for discussion at the Electrochemical Society's meeting at Washington

EDITORIAL STAFF REPORT

ELECTROCHEMISTS from all parts of the country met in Washington, D. C., on October 10, 11 and 12, to attend the semi-annual meeting of the Electrochemical Society. Symposia were held on high temperatures, batteries, electro-organic chemistry and electrodeposition. While this article will be devoted to abstracts on some of the papers, news of the meeting will be found elsewhere in the issue.

The first technical session was devoted to high temperature reactions with Pres. James H. Critchett presiding. Graphite resistor radiation furnaces and their applications to high temperatures was the subject of a paper by Henri George, director of the Electrothermal Laboratory, Cie de St. Gobain, Paris. New radiation furnaces employing a graphite resistor were described in detail.

The six underlying properties required of a high-temperature metal resistor were discussed at length by F. P. Peters of the Wilber B. Driver Co., Newark, N. J. He showed that of all alloys so far commercially produced, the 80-20 nickel-chromium alloy excels. The chromium in this alloy forms a protective oxide of a coefficient of expansion very nearly that of the alloy. It has a very low temperature coefficient of resistance.

In the commercial production of refractory articles made of zirconia, irregularities such as cracking and disintegration were observed by W. M. Cohn of Berkeley, Calif.

Among the other papers presented at this symposium were: the manufacture of plain carbon steels in the top charge, rapid type furnace by W. B. Wallis, Pittsburgh Lectromelt Furnace Corp.; nuclear reactions at stellar temperatures by T. E. Sterne, Harvard College Observatory; the formation and dissociation of silicon carbide by Otto Ruff, Breslau, Germany; method of comparing the hardness of electric furnace products and natural abrasives by C. E. Wooddell, Carborundum Co., Niagara Falls; and impact abrasion hardness of molded boron carbide and of some cemented tungsten and tantalum carbide by L. H. Milligan and R. R. Ridgway, Norton Co., Chippawa, Ont.

Developments in Batteries

The second session was given over to the battery symposium at which the latest data on design, manufacture, test and service were discussed; Dr. G. W. Vinal presided. M. L. Martus, president and general manager of the Waterbury Battery Co., Waterbury, Conn., presented a paper on a high-amperage caustic soda primary battery. The cell was developed because recent developments in railroad signal service have created a demand for a battery that will maintain its voltage at 500 and 1,000 amperage discharge rates. This cell is constructed on a seven-unit basis; seven cupric oxide cylinders, seven sheet zinc cylinders, soldered together, circulating flues, besides a number of other improvements including an automatic closed circuit release. On continuous discharge the performance is much better than that of older unit cylinder type cells.

The effect of temperature and rate of discharge on the capacity of lead-acid storage batteries was discussed by M. F. Chubb and H. R. Harner of Eagle-Picher Lead Co. of Joplin, Mo. A series of curves was submitted which furnish the battery tester a simple means of determining the capacity of a battery for a specified discharge time and at a specified temperature when actual testing is carried out at times and temperatures differing appreciably from those specified. Test temperatures ranged between —18 deg. C. and 38 deg. C. The effect on storage battery performance of standing period between preparation and testing was also discussed by these two engineers.

H. E. Haring and U. B. Thomas of the Bell Telephone Laboratories presented a discussion on the electrochemical behavior of lead, lead-antimony and lead-calcium alloys in storage cells. The authors contend that, for use in storage cells, lead should be alloyed only with metals electronegative to it. A comparative study was made of the electrochemical behavior of pure lead, a 9 per cent lead-antimony alloy and a 0.1 per cent lead-calcium alloy. It was found that on static discharge the Pb-Sb alloy sulphates in approximately 1/9 of the time required for pure Pb and 1/10 the time required for the Pb-Ca alloy.

Anodically and cathodically the behavior of the Pb-Ca alloy is similar to that of pure Pb but quite distinct from that of the Pb-Sb alloy. The indicated electrochemical superiority of Pb-Ca alloy over Pb-Sb alloy was confirmed by actual storage battery tests. It was found that Pb-Ca cells retain their charge for far longer periods than Pb-Sb cells and, also, that they are more efficient. The Pb-Ca alloy was recommended for storage battery grids in place of the Pb-Sb alloy and for Plante type plates in place of lead.

H. E. Lawson, a research engineer with the Burgess Battery Co., found upon submitting various brands of commercial Leclanche cells to accelerated life tests, it became evident that the cells differ appreciably in performance and that it is not generally possible to predict the cell capacity for, say, "intermittent service" from a

"4-ohm continuous test" or vice versa. Accordingly, a systematic study was undertaken of a large number of cells made under similar factory conditions but differing in size and proportions.

C. A. Gillingham, National Carbon Co., discussed quality advances in the dry battery industry. The dry battery is a complicated chemical article incorporating 32 different materials. These are rigidly controlled by chemical and physical tests.

The literature on the current-producing reaction of the Leclanche cell was reviewed by Prof. M. DeKay Thompson, of the Massachusetts Institute of Technology, and the electromotive forces corresponding to air depolarization, and to the reduction of manganese dioxide to Mn_2O_3, Mn_3O_4 and MnO were recalculated.

Other papers of interest covered: standards of electromotive force by G. W. Vinal, D. N. Craig and L. H. Brickwedde, Bureau of Standards; the influence of hydrogen ion concentration on the potential of African manganese dioxide by N. C. Cahoon, National Carbon Co.; a radio "B" battery of flat type construction by A. Karl Huntley, National Carbon Co.; and experiments in the formation of active materials for alkaline storage cells by J. G. Zimmerman of Madison, Wis.; some physical and metallurgical properties of lead-calcium alloys for storage cells grids and plates by E. E. Schumacher and G. S. Phipps of the Bell laboratories; stibine detected in gases evolved from lead storage batteries by Haring and K. G. Compton of the same laboratories.

Electrodeposition

The symposium on electrodeposition, electro-organic chemistry and related subjects was held on Saturday morning with W. W. McCord in the chair. Russell Harr of the chemical engineering laboratories at the University of Wisconsin, presented a paper on inorganic addition salts in nickel plating solution. The effect of inorganic addition salts commonly added to rapid nickel plating solutions was shown by means of the Krombholz test for metal distribution, a test for critical current density, current efficiency and resistivity. The addition salts investigated were sodium, magnesium and aluminum sulphates, boric acid, and ammonium chloride.

Concentrated copper cyanamide plating baths were discussed by L. C. Pan, chemical engineer of Shanghai, China. In an earlier publication the author showed that maximum efficiency may be obtained from a cyanide copper plating bath in which the copper concentration is 1 N (63.6 g. per L.). The effect of free cyanide and carbonate upon such a bath was now studied in order to determine the optimum concentrations of these constituents. Upon comparing a bath containing 1 N copper, 0.17 N free cyanide (8.3 g. per L. LaCN) and 1.5 N sodium carbonate with the commonly used acid-copper sulphate bath, distinct advantages in favor of cyanide bath are recorded.

The electrodeposition of tin and its alloys was the subject of a paper by Prof. L. E. Stout and August Erspamer of the chemical engineering department, Washington University, St. Louis. Lactic acid appears to be the best addition agent in the plating of tin from alkaline stannate baths. A concentration of 0.6 g. per L. gives the best deposit. Malic acid, ethylene glycol, and tartaric acid also worked well, although they did not give quite as good deposits as did lactic acid. Other additions studied were sodium perborate, sodium biborate, casein, glucose, starch, triethanol amine, and glycerine. Increasing the alkalinity of the bath reduces the weight of the deposit. Varying the concentration of the addition agent has an effect on the weight of the deposit. With some addition agents, a certain concentration of the addition agent causes a maximum weight of deposit to form, while with other addition agents, a deposit of minimum weight forms.

Chromium Plating

Raymond R. Rogers, a lecturer in electrochemistry at Columbia University, reported on the results of his studies in the theory of chromium electrodeposition. The theories which seem to apply to the deposition of the more noble metals from aqueous solutions do not apply in general to the base metals. Selecting the electrodeposition of chromium as a typical case, numerous experiments were carried out under widely different conditions. The results support the conclusions: (1) that the film of electrolyte in intimate contact with the cathode is more alkaline than the main body of the bath; (2) that this film must have a definite pH value for metal deposition to take place; (3) that the final reduction of chromium to the metallic state is due to atomic hydrogen and not to a mere electron exchange between cathode and positively charged metal ions; (4) that the amount of atomic hydrogen available at the cathode must be maintained within well defined limits. The theory developed undoubtedly has general application. Evidence is presented in support of the theory that even the most active metals may be electrodeposited from aqueous solutions.

Sherlock Swann and two of his students at the University of Illinois presented a second paper in their series on electrolytic reduction of ketones in glacial acetic acid. The new one concerned the reduction of aliphatic ketones to hydrocarbons. The optimum conditions for the electrolytic reduction of methyl n-propyl ketone to n-pentane in glacial acetic acid have been determined at cathodes of cadmium, tin, lead, mercury, aluminum, zinc, nickel, copper and iron. The yields of n-pentane correspond with the hydrogen over-voltages of the cathodes. The best yield of n-pentane is obtained in aqueous solution at a cadmium cathode.

The electrolytic reduction of nitro compounds in concentrated aqueous salt solutions was discussed by Prof. Ralph H. McKee and Basil G. Gerapostolou of Columbia University. Conditions governing the formation of highly insulating anodic layers on aluminum was the subject of a paper by J. E. Lilienfeld and associates at the Ergon Research Laboratories. Palladium-hydrogen was discussed by Prof. Louis Kahlenberg and William Krause of the University of Wisconsin; errors in corrosion research by R. B. Mears and H. E. Daniels of Cambridge University, England; the simultaneous discharge of nickel and hydrogen ions from the solutions of simple nickel salts by O. Essin and E. Alfimova, Ural Phisco-Chemical Institute, Sverdlovsk, U. S. S. R.; electrolysis of aqueous solutions of alkali sulphates by W. W. Stender and J. J. Seerak State Institute of Applied Chemistry, Leningrad; and sodium discharge potential at the mercury cathode by W. W. Stender, M. M. Stroganov and P. B. Zivotinsky.

Other Process Industries Forge Ahead

Last month under the title: "What Are the Achievements of Chemical Engineering?" we published a staff review of outstanding developments in certain chemical and process industries. Here is the concluding installment in the series which began in May.—EDITOR.

DURING the recent San Francisco meeting of A.C.S., chemists of the duPont company predicted that the production of insecticides in the United States would rise from $20,000,000 to $150,000,000 within the next few years. This dramatic expansion, they held, will come largely through the development of new synthetic, organic compounds—many of which are less poisonous or entirely harmless to human beings yet more effective than the metallic and inorganic chemicals. The U. S. Bureau of Entomology has pointed the way with its discovery that phenothiazine can be successfully used as a stomach insecticide to control the coddling moth and other pests which have given so much trouble with fruit. Two seasons of experimentation on a wide scale in two parts of the country has shown this chemical to be at least equal in effectiveness to lead arsenate. The material is cheap, can be very easily applied and hence promises to have important usage replacing the metallic compounds with which so much trouble is being experienced because of poisonous spray residues left on fruit and vegetables ready for market.

The Grasselli Chemical Co. has conducted extensive investigations in California and Washington, in an effort to develop better and less poisonous or non-poisonous insecticides. Some of the insecticides being investigated are barium fluosilicate, manganese arsenate, lorol rhodanates and several new organic compounds.

In the field of household insecticides the outstanding development has been in the use of mixed pyrethrum extract and rotenone. The Standard Oil Co. of N. J., with "Flit," has shown the way to secure a combination of quick-action which comes from pyrethrum and high toxicity which is gained from rotenone. Substantially all household sprays of this type now use this double insecticide type of formula.

The use of rotenone in the form of ground derris for dusting of cabbage, beans and other green vegetables has also proved of tremendous advantage to the market gardeners who wish to avoid the problem of elimination of toxic metallic spray residues. Thus vegetables for household use, as well as those for commercial canning, may be eliminated from the classes which are under suspicion of objectionable metal content as policed by the Food and Drug Administration.

Industrial fumigation of food products, of goods on shipboard, and for miscellaneous items in chemical and process industries, has been significantly advanced through the widespread development of vacuum fumigation, using principally mixtures of ethylene oxide and carbon dioxide. Literally hundreds of plants now achieve virtually complete insect pest control through this general type of fumigation of products. Space fumigation with cyanide, of course, still continues as one of the outstanding developments for control of plant conditions as a whole, as distinct from treatment of the food itself and the other industrial products.

Soap Accelerates

For years it was our habit in reviewing the soap industry to start out with an apology to the effect that there was a lack of anything basically new in soap making as far as its chemical processes were concerned. Then would follow a review of the important advances made in mechanical equipment or reference to the development of spray drying or other processes affecting only the physical form of the product. But along in 1933 came the so-called "soapless detergents," the sulphated higher alcohols of the fatty acids, with their remarkable properties of lathering freely in even the hardest waters. (See *Chem. & Met.*, May, 1933, p. 249). Originally of foreign origin, to be sure, these processes and products have been studied and improved through the work of a number of American companies, notably Procter & Gamble, duPont, and the National Aniline & Chemical Co. The soap industry, stirred by this infusion into its ranks of organic chemistry of a new order has counter-attacked along several lines. One of these was the use of sodium hexametaphosphate as an adjuvant to soap. This is said by some to put the older product back onto a basis where it can compete in performance with the results obtained with the higher fatty acid sulphates and at a lower cost.

Another line of development, which may have been under way and under cover for a number of years, has recently attracted chemical engineering attention in the soap industry. We refer to the use of an accelerator or catalyst for the rapid saponification of fats and oils and the use of an inhibitor to prevent deterioration (oxidation, rancidity, discoloration, etc.). Soap Manufacturies, Inc., with which Wurster & Sanger, Inc. are associated as chemical engineers, have put such a process into large-scale commercial operation in a demonstration plant in Chicago. The results obtained to date are extremely interesting, although as its sponsors point out, the process is not likely to revolutionize the entire soap industry because of its relatively limited field of application to certain kinds and grades of soaps, such as high-quality toilet soaps.

As in the case of many other industries, the soapmakers generally are being convinced of the great value of inhibitors to prevent or retard undesirable reactions. Thus it has long been known that soaps which come into contact with copper during manufacture will spot and discolor due to rancidity brought about by the catalytic action of the copper. Iron rust has also been troublesome. Elaborate and costly precautions in equipment construction have been taken to avoid contact with copper and iron rust. Now the addition of a small amount of inhibitor avoids all such difficulties.*

Cement, Ceramics and Glass

What will very possibly be found to have been the most important development made in many years in the portland cement industry is the process of raw material "taking-apart-and-putting-together" set in operation during 1934 by the Valley Forge Cement Co. By the use of hydroseparation, hydraulic classification and froth flotation this company has been able to utilize whatever raw material was available for the pro-

*In this connection it is interesting to learn that one of the largest companies, which has long been under chemical engineering direction, secretly introduced and used inhibitors as long ago as the beginning of the present century. EDITOR.

duction of any desired type of cement (see *Chem. & Met.*, February, 1935, p. 68). The process not only has made the plant independent of its raw material supplies but has given added benefits which alone pay for the separation processing.

Several developments in ceramics and glass mark the recent past. From Europe came a process of tempering glass which has been developed by Libby-Owens-Ford Glass Co. to the point where the glass so treated is enormously increased in strength, is more elastic than steel and shatters into particles of harmless character. Corning Glass Works, called upon to cast an astronomical mirror much larger than any heretofore produced, after much experiment succeeded in casting not one but two satisfactory 200-inch mirrors of borosilicate glass. O. Hommel Co., working in its chosen field intermediate between glass and ceramics, greatly simplified metal enameling through the introduction of what is said to be the first successful single-coat enameling process.

In strictly ceramic fields perhaps the most far-reaching development is that of light-weight refractories, brought out independently by several different concerns. These materials are of primary interest for their heat insulating qualities, although similar materials are being perfected for structural purposes, lower temperature insulation and sound insulation. Certain advantages over conventional fired refractories, including extremely high density and negligible volume change at high temperatures, are apparent for the unfired refractories recently brought out by the General Refractories Co. These materials, using selected particle sizes and a refractory chemical bond are molded to true dimensions under pressures as high as 10,000 lb. per square inch.

Improved Sugar Technology

An engineering commentator known throughout the sugar industry for the keenness of his observation and the economic soundness of his judgment, reports that there have been no revolutionizing advances in that field since 1933 but "a vigorous nibbling for improvements all along the line." "It has been less popular," he writes, "to reduce the number of operatives, but rather to make revisions in operating technique to improve the quality of the product and to increase the efficiency of the old equipment." He continues as follows:

> The most spectacular installations are the new calandria pans with Webre circulators. (A contribution of the sugar department of the U. S. Pipe & Foundry Co., *Chem. & Met.*, May, 1933, p. 253.) The general advantages of circulators were thought to have been known when crude machines were installed and more or less abandoned thirty years ago. Webre's research and the translation of his findings into a rugged machine have developed advantages not anticipated. The new installations improve the color by avoiding local over-heating; promote uniformity of grain; reduce the time of boiling; permit reduced steam pressure; and increase the yield per strike by boiling to a higher percentage of "dry substance." The recording ammeter on the circulator drive-motor provides control data, since the power demand is a true measure of the viscosity.
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> The building of the sugar crystals in the pan has passed through the stage of artifice to art and is now becoming a science. Through the work mainly of Walter E. Smith, technologist of C. Brewer & Co., Ltd. of Honolulu, apparatus which mechanizes science is now being perfected and will make sugar boiling a standard and automatic procedure.
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> The conventional speed of the centrifugals at about 1,000 r.p.m. was suddenly increased when Roberts of the Western States Machine Co. and others sensed the advantages and found metals that permitted greater loads. In one refinery a new $100,000 installation now on order is expected to increase the yield of the station by 400,000 lb. daily. The quick acceleration more effectively removes the viscous liquor from the crystals so that less wash-water is required and correspondingly less re-processing.
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> The Stevens revolving spiral pipe coils, developed by the same group for hot water circulation in the bottom of the mixers, maintain a uniform temperature and a low viscosity of the mother liquor and thereby improve spinning qualities. The same device in the crystallizer mixer permits advantageous cooling in the crystallizers and then just before discharge to the centrifugals, provides rapid reheating without remelting an appreciable amount of grain. Likewise in the washhouse mixers, it improves spinning quality and reduces wash-water requirements. Automatic pH controls are now applied everywhere to remove former unreliability. Steam-flow meters have furnished information which in some cases has reversed conjecture. Recent installations of heat exchangers are recovering an equivalent of 200,000 lb. of steam per day from hot waste water. Heat exchangers for pasteurizers for thick molasses get half of the heating effect and all of the cooling from waste waters that formerly went to the sewer.
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> In recent months a new specific gravity separator has been installed in many refineries for discarding impurities from the bone char. This machine separates sand and metal particles and removes large grains of char which look good to the eye but have no decolorizing value. In some refineries these machines have discarded as much as 10 per cent of the weight of the char as being valueless.

Pulp and Paper Achievements

The pulp and paper industry has been undergoing a great many changes in recent years as a result of the belated recognition of the rôle of the chemical engineer. One of the most interesting developments that is quietly taking place is the production of a variety of chemicals from waste liquors. Like the petroleum refinery the pulp mill may soon find the chemical department an important branch of its activities. Waste from sulphite liquors is utilized in road building in the Pacific Northwest, in the manufacture of yeast in Nova Scotia, in recovering monosulphite and lignin in Wisconsin, and there are plans definitely under way for fermentation to yield higher alcohols and production of vanillin.

An important recent achievement of the Kimberly-Clark Corp. is the forced circulation system with indirect heating for sulphite pulping combined with automatic control of the admission of steam and the relief of liquor and vapor. The same company has also produced a coated paper, Kleerfeet, with the coating applied as a part of the paper machine operation.

An efficient spray sulphur burner has been developed by the combined efforts of the Texas Gulf Sulphur Co., the Institute of Paper Chemistry and the Kimberly-Clark Corp., which regularly produces 19½ per cent SO_2 gas with 0.15 per cent SO_3. It is operated in conjunction with a waste heat boiler.

There is continued activity in the utilization of a wide variety of wood species. Outstanding achievements might be indicated by the use of hardwoods for sulphite by the Brown Co. and several others, by the use of hardwoods for bleached sulphate by the Howard Smith Co., by the Herty developments and by the use of such species as Douglas fir for sulphite.

The S. D. Warren Co. has developed the application of an air jet delivered through a long narrow slit to the smoothing of the wet coated sheet in place of the usual wet brushes. The old festoon dryers are being replaced by enclosed dryers of various designs.

Prior to the operation of the pulp division of the Weyerhaeuser Timber Co. at Longview, Washington, sulphite pulp from the Northwest was not a standardized product and was generally regarded among paper makers as being of inferior quality. The Weyerhaeuser company by means of modern manufacturing equipment developed by a competent engineering staff has convinced the paper making fraternity of the merits of West Coast sulphite to the extent that this product now competes on an even basis with the best bleached sulphites, either domestic or foreign.

Developments in Chemical Treatment Of Sewage

AT THE REQUEST of Senator Augustine Lonergan, a conference was held last December at Washington, D. C., with the Secretary of War with reference to the proposal to create a federal authority over stream pollution and stream purification. Included in the report of the conference was a brief review of the most recent developments in the chemical treatment of sewage by M. J. Blew, research engineer of Philadelphia, which appeared in the October issue of *Public Works*.

Research work is being carried on to develop and improve chemical treatment. The improvements will to some extent be functional but will mostly consist of controls and equipment for use in the process. At the present some 15 processes are being developed, the principles involved in all being about the same but the means of accomplishment varying. They include the use of chemical coagulants, insoluble solids and materials for removing dissolved organic matter. Among the coagulants used are ferric chloride and ferric sulphate, ferrous sulphate, alum, sodium aluminate, copper sulphate, chlorine and lime. Insoluble solids include paper pulp, marl, cement dust, returned sludge and ground charred sludge. Some of the processes include filtration of the sewage through various types of sand, coal or special medium filters. The use of zeolite filters for the removal of ammonia is proposed under one of the processes, and the use of chlorine to fix or precipitate organic matter and as a further oxidizing and sterilizing agent is a part of some of them.

Brief descriptions of several of the processes referred to are given herewith.

Laughlin process: Plant in operation for two years at Dearborn, Mich., capacity 30,000,000 gal. daily. Process: 1. Add ferric chloride or ferric sulphate and lime to the raw sewage; also paper pulp, which improves filterability and accelerates rate of filtration, and is claimed to accelerate rate of settling of coagulated solids. 2. Coagulated solids removed by combined settling and filtering tank, radial flow type, detention period one and one-half to two hours. Upward flow filter annular in plan, attached inside the outer wall of tank, comprises 2 or 3 in. of crushed, screened and sized iron ore resting on a bottom of screens and plates. Floc, retained under this "magnetite sand," is washed out by a pulsating magnet which continuously traverses the entire filter surface. lifting the sand. Nominal rate of filtration, 1½ to 2½ gal. per min. per sq.ft. 3. Settled sludge removed from tank mechanically, conditioned, and dewatered on vacuum filters. 4. Effluent oxidized and sterilized with chlorine.

Guggenheim process: Demonstrated at 2,500 gal. per day plant in New York City and 25,000 gal. per day experimental plant in Chicago. Process: 1. Raw screened sewage is coagulated with ferric sulphate, with air agitation to keep iron in ferric condition; followed by lime to give dense, rapidly settleable floc. 2. Coagulated solids settle in clarifier, removed mechanically and dewatered on vacuum filter, and burned in rotary kiln incinerator. Ash from incinerator treated with sulphuric acid to regenerate ferric sulphate, which is reused for coagulation. 3. Effluent from clarifier passes through zeolite reactor bed in which the sodium ions replace the ammonia nitrogen groups, which, when the zeolite is regenerated with salt water, are removed in that water and are recovered from it by distillation and condensation.

Lewis process: Under experimental operation in 500,000 gal. per day plant at Atlanta, Ga. Process: 1. Ferric chloride and lime are added to raw screened sewage, followed by ferrous sulphate and "Cotrell" dust (cement dust). A pH of 10.0 to 10.5 maintained throughout the process is the controlling feature. 2. Coagulated solids removed from settling tanks mechanically, and dried on sludge beds, or can be dewatered on vacuum filters.

Stevenson process: Experimental plant, 36,000 gal. per day capacity, constructed at Palo Alto, Calif., by Great Western Electro-Chemical Co. Process: 1. Screened sewage detained two and one-half hours in primary settling tank, then ferric chloride is added in a two-stage mixing tank (no lime used), and coagulated solids settle in secondary settling tank with one and one-half hours detention period. 2. Chemical sludge from secondary tank is returned to and mixed with raw sewage entering the primary tank. 3. Sludge from primary tank digested in separate tanks, or conditioned and dewatered on vacuum filters.

Streander process: Experimental plant, 25,000 gal. per day capacity, operated 18 months at Philadelphia Northwest Sewage Works; sewage contains grease and trade wastes. Process: 1. Ferrous sulphate and lime added to raw screened sewage in a flocculation tank, forming at once ferrous hydroxide which readily absorbs oxygen, which air blown through the mixture plus absorption of atmospheric oxygen converts to ferric hydroxide, prevents return to the ferrous form, and satisfies immediate oxygen demand of the sewage liquor. 2. In circular, radial-flow, settling tank, one and one-half to two hours detention period, solids settle and effluent flows to a submerged filter bed annular in plan, surrounding the tank and constructed integral with it. Filtering rate, 1½ to 2½ gal. per min. per sq.ft. filter area. Filter medium, 9 in. of sand or anthracite coal supported on a screen and plate. Retained floc removed by water-jet rakes inside a cleaning caisson and returned to raw sewage. 3. Sludge removed from tank by mechanical scrapers and dewatered on vacuum filters. 4. Effluent from filter sterilized and oxidized by introducing chlorine in an air-actuated contact and oxidizing tank.

Where sludge is to be incinerated, Streander proposes modification of process, first removing 30 to 40 per cent of suspended solids by screening bar-screened sewage through revolving coal mat at rate of 40 gal. per min. per sq.ft.; treating effluent in flocculation tank as above; and in settling tank with one to one and one-half hours detention period, and through filters as above; sludge from settling tank being returned to sewage entering the coal mat filter, and all sludge from this filter (with some of the coal) is mechanically dewatered and incinerated in a combined kiln dryer and stationary combustion hearth.

Wright process: An entirely new principle in mechanical removal of suspended solids developed at activated sludge plant at Rockville Center, N. Y. Process: 1. Clarification of raw sewage in primary settling tank. 2. Clarified sewage pumped to vacuum filters, pulped paper being added just ahead of the filters and forming the filter mat; pH maintained at optimum for filtration by adding lime. 3. Vacuum filter effluent goes to aeration tank and then to final settling tank. 4. Effluent from final tank cleared of fine pin-point floc on other vacuum filters. 5. All derived sludge is dewatered on vacuum filters, using higher vacuum than for sewage. 6. Dewatered sludge cake is burned in municipal refuse incinerator. It is proposed to use the same process without preliminary sedimentation, in which case the raw sewage and pulp are filtered as in 2, but the filter mat is further dewatered on another vacuum filter, bringing the moisture content down to 70-75 per cent.

Landreth process (originally termed the "direct-oxidation process"): In operation in Winston-Salem, N. C., for about seven years. Uses lime in amounts to secure caustic alkalinity, presumably to condition the sewage for the electrolytical treatment which is the prominent feature of the process.

Cabrera, in a 60,000-gal.-per-day experimental plant in Wilmington, Del., uses aluminum sulphate and returns part of the settled sludge to the raw sewage for the further absorption of organic matter.

Travers, in a 500,000-gal.-per-day plant in Ashland, Ohio, used ferrous sulphate, lime, marl, and aluminum sulphate.

Among other experiments may be mentioned Downes' use of ferric sulphate at Plainfield, N. J., to reduce load on sprinkling filter: Tatlock's work on a lime-chlorine process for odor control at Dayton, Ohio; Hendon for the proposed Birmingham, Ala., plant; and the Diamond Alkali Co. of Cleveland, Ohio, using ferric chloride, chlorine with or without lime.

Results secured: Sufficient time has not elapsed to secure clear and definite operating results and cost data. From

reported results, the reductions in suspended solids and B. O. D. are as follows:

Process	Reduction in percent: Suspended solids	5-day B.O.D.	pH range
Laughlin:			
Dearborn, Mich...	91	68	7.5 to 9.1
Coney Island, N. Y.	84	69	9.0 to 10.3
Guggenheim:			
New York City..	95	95	6.0 to 8.0
Chicago, Ill.....	95	90	
Lewis, Atlanta, Ga..	76	77	10.0 to 10.8
Stevenson, Palo Alto, Calif.	84	60	6.8 to 7.4
Streander, Philadelphia, Pa. 92-95		75-80	8.0 to 8.5
Landreth:			
Winston-Salem, N. C.	87	88	
Chicago, Ill.....		66-72	
Travers, Ashland, Ohio	85	50	
Cabrera, Wilmington, Del.	89	78	

There appears to be ample evidence that the known processes involving chemical precipitation in one form or another, will produce a degree of treatment equal to a reduction in biochemical oxygen demand of between 60 and 75 per cent. When followed by rapid filtration, the appearance of the effluent is materially improved and, in addition, the B. O. D. reduction will amount to between 70 and 85 per cent. The Guggenheim process produces results well comparable to the performance of the better-operated activated-sludge plants, but at increased operating cost.

Operating costs: The data covering costs of operation of chemical sewage-treatment plants on normal sewage are as yet meager and somewhat unconvincing. They range from as low a figure as $6 to as high as $45 per 1,000,000 gal. Comparative costs are somewhat difficult to analyze, as the character of the water used, the presence of industrial wastes, the pH of the raw sewage, etc., all have a very direct bearing on the quantity of chemicals required and, consequently, the cost of treatment. Streander in Philadelphia, using the inexpensive ferrous sulphate and lime, with air flocculation and oxidation for a period of 20 to 30 minutes, reports the cost of chemicals and power for compressed air to be as low as $6 per 1,000,000 gal. Operating costs for the Laughlin process, based on operating tests at Dearborn and Coney Island, using paper pulp, lime, and ferric chloride, show chemical costs at about $8 or $9 per 1,000,000 gal. At Atlanta, the tests on the Lewis process gave chemical and cement-dust costs at about $12 per 1,000,000 gal. Total operating costs, including chemicals, power, labor, repairs, maintenance etc., but not including fixed charges, will probably range between $8 and $20 per 1,000,000 gal., depending upon the size of the plant and the method of treatment used.

Construction costs: Construction costs vary to a great extent, depending on the method of treatment used and the treatment and disposal of the derived sludge. The size of the plant, or its capacity, also has a decided bearing on the cost of construction. Generally the cost should range between $50,000 and $100,000 per 1,000,000 gal.

Industrial Wastes

INTENSIVE STUDIES of industrial waste pollution have been made by various federal and state agencies and by some industries through their national associations, according to a report of the Special Advisory Committee on Pollution of the National Resources Committee. As a result of the studies, a number of industries have made plant changes for recirculation and re-use of waters formerly wasted, or for recovery processes which salvage waste products of some value. A list of the most serious industrial wastes is presented in the accompanying table which is part of a report by Chairman S. T. Powell of the joint committee of the American Institute of Chemical Engineers and the American Society for Civil Engineers on pollution of waters.

The incomplete replies to the questionnaires of the National Resources Committee report a total of 523 industrial waste-disposal plants treating various types of waste in 23 states. Eight states report no such disposal plants. The investment in such plants for the prevention of water pollution is estimated approximately, on the basis of incomplete data, at $22,000,000. In addition, West Virginia, Pennsylvania, Ohio and Alabama have expended about $520,000 up to 1935 for sealing abandoned coal-mine openings, the work being carried on under federal and state Civil Works Administration and work relief by methods devised by the U. S. Bureau of Mines as a result of studies of acid mine wastes.

In practically no instance in the 29 states reporting the extent of cooperation by industry is there strictly official cooperation with representatives of the state in matters of water pollution. Notable approaches to such cooperation appear to be in Rhode Island, where industry has representation on the Board of Purification of Waters; and in Oregon, where the State Stream Pollution Committee has representatives from industries.

Cooperation by officials of various industries with state agencies has worked to the advantage of both in a number of instances. These include: the regulation of waste discharge in accordance with stream flow conditions, involving in some cases daily examinations by the industry of the receiving water during periods of low flow (Maryland and Iowa); the report of daily operating results of industrial waste-treatment plants (Ohio), and accidental spills of taste-producing substances that might affect water supplies on the streams below (byproduct coke manufacturers in Pennsylvania, Ohio, West Virginia and Kentucky); assistance in research on waste-disposal problems peculiar to the industry (Illinois, Maryland, Michigan, New York, North Carolina, Pennsylvania, Wisconsin); and aid in making stream pollution surveys (Maine and Maryland).

Serious Industrial Wastes

Nature and Source of Waste	Intensity: B.O.D. 5-day	Intensity: Population Equivalent	Relation to Volume of Production: Unit of Product or Labor	Relation to Volume of Production: Kg. Oxygen Consumed
Paper Industry:				
sulphite liquor	1,300	....	1 ton pulp	647.7
sizing	610	....	.....	.....
white water	20	....	.....	.....
leather board	.....	7.7	1 ton	44.0
strawboard	.....	4.7	1 ton	151.5
straw and paper board.	61	2.3	1 ton	73.0
general	.....	1.0	1 ton paper	29.9
Tanning Industry:				
general	14,000	....	.....	.....
hide	.....	6.7	1 skin	1.26
calf	.....	6.7	1 skin	.35
sheep	.....	5.7	1 doz. skins	.13
harness leather	.....	5.8	.....	.....
Textile Industry:				
wool scouring	.....	25.1	100 lb. raw material	1.55
wool yarn cleaning-scouring	.....	1.1	100 lb. raw material	1.27
dyeing	.....	2.9	100 lb. raw material	.76
dyeing-scouring	.....	2.3	100 lb. raw material	7.11
cotton yarn dyeing	.....	2.4	100 lb. raw material	6.35
cleaning-bleaching	.....	3.1	100 lb. raw material	1.31
bleaching-dyeing	.....	2.8	100 lb. raw material	6.16
bleach-dye, finish	.....	0.2	100 lb. raw material	.77
Dairy Industry:				
general	260	10.8	100 lb. milk	.17
creamery	405	9.2	100 lb. butter	.09
Laundry	327	....	100 lb. clothes	.81
Canning Industry	915	2.3	1,000 lb.	3.50
Corn Products	.....	3.0	.....	.....
Starch Mfg.	1,770	12.7	1 bushel corn	.59
Brewing Industry	.....	10.8	1 barrel	.71
Distilling Industry	17,500	87.5	1 barrel	22.07
Rubber Reclaiming	.....	24.0	.....	.....

Wastes for which quantitative data are lacking: Rayon, steel and iron, chemicals, sugar, gas manufacture, oil refineries.

Reader's VIEWS AND COMMENTS

Dendro-Chemistry Not Utopian

To the Editor of Chem. & Met.:

Sir—In criticizing my statement on acetate of lime manufacture (see *Chem. & Met.*, September, pp. 506-7), our chemical engineering brother, Dr. Othmer, says that I asked for "Utopia" and he repeated it eight times. He also said that "time has dulled his (my) memory." He further refers to my "philosophy." Because of these many personal allusions I must "rise to a question of personal privilege" and refute his conclusions for the benefit of recent entrants into the industry. The veterans will need no explanation as they know both the writer and the facts.

The "Utopia" refers to a described co-ordination of byproduct wood distillation with charcoal furnace and lumbering operations. When my patents were issued, there were in Wisconsin and Michigan, 11 charcoal iron furnaces; ten of them had contiguous charcoal plants and eight also had nearby lumber mills. In addition, there were five other byproduct plants not contiguous to charcoal furnaces but three of them had lumber mills alongside. Only two were not financially controlled by the furnace interests. This may have been "Utopia" but we thought it "hell" because at that time the wood-alcohol industry was threatened by the new industrial alcohol laws just as it is now threatened by synthetic products. Nearly all who have been in wood distillation for 30 years or more, were and are pessimists as the result of experience. A visit two years ago to all of the 11 furnaces above mentioned disclosed that all but one are now idle or abandoned. Only one new furnace has since been built in this region —one a (Model T) byproduct plant. The furnaces demanded 2,200 cords of wood per day so these were large plants, nearly all of which then or later were licensed and/or used the patented processes of the writer.

All of the plants in Western Pennsylvania and New York were then small, but enjoyed almost costless natural gas and crude oil for fuel. Only a few were then or are now connected with lumbering operations so "there has been a tremendous increase in cost of production" for these small plants whose gas has gone and whose fuel cost is now excessive. This is especially true of those who continue to operate on the old system or by any new method that uses a large amount of primary steam instead of the free exhaust steam of a furnace or sawmill. I repeat my contention that any wood distillation plant not connected with a furnace and/or sawmill is doomed to speedy bankruptcy whether it makes acid or acetate unless there is some extraordinary charcoal market or it can find cheap fuel and wood for charring.

As to the "philosophy" expressed in *Trans. A. I. Ch. E.*, Vol. 13, No. 1, p. 376, this article, as anyone can see, is a record of improvements in dendrochemistry and contains no "philosophy" unless the so-called "Utopian" reference to the connection of the wood distillation industry with the charcoal furnace is so regarded. That practice was 20 years old even then. Time has not dulled my memory. It is with acuteness that I recall the many past attempts to devise new processes and the many mistakes that always worry the beginner with his "several years contact" with the industry.

My prior communication was intended only to show that the necessary evaporation and consequent steam consumption are equal or greater in direct acid manufacture than in acetate of lime production. Othmer's own figures as to live steam cost were accepted and we showed that exhaust steam had no cost. His unsupported statement and references to mysterious and undisclosed "withdrawing agents" are inappropriate in a scientific article.

Referring to the Albin communication in your same issue, it is sufficient to point out that the Suida process was anticipated by me in U. S. Patent 1,250,282 where pyroligneous acid is "systematically scrubbed with a countercurrent of distilled oils from tar." I knew better than to work it out commercially after Klar had lost so much money on it.

With wood distillation acid or acetate competing with acetic acid now produced by fermentation of alcohol to vinegar, with "grain" alcohol now being made in large quantities from ethylene or from acetylene obtained from carbide or oil gas and with further synthetic methods threatening acetic acid from methanol and CO, the plight of the dendro-chemist is indeed not Utopian.

H. O. CHUTE
Chemical Engineer,
50 E. 41st St.,
New York.

Wood Chemical Industry Will Profit and Progress

To the Editor of Chem. & Met.:

Sir—I am sure that everyone has enjoyed the opportunity to read of the history of the wood chemical industry, the ideal type of wood chemical plant and Mr. Chute's connection therewith; and I feel that a worthwhile result of my answer to his criticism in the September issue, is the fact that a still further chapter in this history is hereby put on record.

It has been farthest from my thought to try to minimize the influence which Mr. Chute has had on this basic industry, even if it were in my power. Naturally, no offense has been intended; and the industry as a whole, and myself in particular, are indebted to him for his early and active work in this field.

Most of the plants with large investments and many years' background will hesitate to adopt his outspoken contention that they are doomed to speedy bankruptcy, as not being able to fulfill the conditions which he outlines; and these will probably want to try some remedy before quietly giving up the ghost.

His reference to the tottering industry, in his September letter, his commiseration with the unhappy plight of the operator of the wood chemical plant, and his general belief that the whole industry will be a thing of the past within the next few years is certainly not justified by the facts as is demonstrated by any number of plants which are now operating and will continue to operate. Mr. Albin and the other progressive chemical engineers in the industry are certainly not daunted by the scare psychology with which Mr. Chute buries the industry.

In his criticism of my failure to disclose the nature of the withdrawing agent used, covered by allowed but not published patents, he is at variance with his philosophy on the aptness of human nature to appropriate ideas, which he himself expressed in *Trans. A. I. Ch. E.*, Vol. 13, No. 1, page 376, where he says, "It may be remarked here that the author never found any so-called business man who would recognize any intellectual property whether covered by

(Continued on page 565)

Chemical Engineer's BOOKSHELF

Berl, Vol. III

CHEMISCHE INGENIEUR—TECHNIK, VOL. III. Edited by *Ernst Berl.* Published by Verlag von Julius Springer, Berlin. 580 pages. Introductory price for series of three volumes, 248 Rm. Volumes not sold separately. Later subscription price will be 310 Rm.

Reviewed by *S. D. Kirkpatrick*

TWENTY-FIVE SECTIONS are included in the third and final volume of Prof. Ernst Berl's handbook, the first and second volumes of which were reviewed in the March and July issues, respectively, of *Chem. & Met.* Most of the authors have already appeared in one or more sections of the previous volumes, and the same method of treatment as formerly used is continued throughout. The following subjects have been treated:

Crushing and Grinding, by Carl Mittag, Magdeburg-Buckan; Screening; Agitation; Mixing; Kneading; Extraction; Pressing; Melting; Sublimation; Evaporation; Distillation and Rectification, all by Dr. K. Thormann, Breslau; Ore Concentration, by Dr. H. Schranz, Magdeburg; Flotation, by Prof. Berl, Dr. H. Schranz, and Dr. Bernh. Schmitt, Ludwigshafen a. Rh.; Crystallization; Centrifuging; Filtration; Removal of Liquids by Pressure; Washing of Gases, all by Dr. F. Hegelmann, Ludwigshafen a. Rh.; Low Temperature Technique, by Dr. M. Gompertz, Berlin; Recovery of Liquid Solvents; Drying of Gases; Purification of Gases; Decolorization of Liquids, all by Prof. Berl and Dr. R. Bemmann, Darmstadt; and Colloid Mills and Chemistry of Emulsions, by Dr. A. Chwala, Vienna.

Enameling Art

ENAMELS. THE PREPARATION, APPLICATION, AND PROPERTIES OF VITREOUS ENAMELS. By *Andrew I. Andrews.* Published by the Twin City Printing Co., Champaign, Ill., 1935. 410 pages. Price, $5.50.

Reviewed by *T. R. Olive*

IT IS SELDOM that a reviewer can find less fault with a first edition than the present reviewer has found with the current volume. With the exception of two or three minor criticisms, one of which is perhaps not entirely justified, Professor Andrews' work must receive an unqualified accolade. Apart from the obvious merit of the book, to accord it less would be presumptious in view of the commendations and endorsements that have already been given it by the country's best qualified critics, the Fellows of the American Ceramic Society and the Porcelain Enamel Institute.

The author, who is not only a ceramist of note but also a chemical engineer, thus brings to this first comprehensive American text on enameling a background which fits him peculiarly to deal with so complex a subject. The result is a well rounded presentation, appealing alike to the student and to the practical man and manufacturer, which offers a balanced content of physical chemical theory judiciously combined with a wealth of information on technique and equipment. Extremely liberal use of phase diagrams and of tabular matter adds to the reader's comprehension and to his immediately useful knowledge. A thorough review of the literature, with a filling in of the gaps from the author's personal experience, puts the reader in the position of owning a one-volume reference library.

The treatment is logical, dividing the subject into 12 sections, commencing with a brief history of enameling, progressing through a review of the raw materials employed and the ceramic fundamentals governing the various glasses which are the enameler's stock in trade. Two chapters on the chemistry of cast iron, sheet iron and steel and on the forming and preparation of the metal lead naturally to two further chapters on calculations and frit compositions. Four chapters on the manufacturing phases follow, covering frit making and milling, enamel application and firing. As a fitting finale, the last section goes thoroughly into enamel properties and defects, and tests.

Perhaps if the reviewer had more than a superficial knowledge of enameling art and science he could offer a more suggestive criticism than that considerably more material be included in future editions on the acid-proof enamels used for chemical ware. Perhaps he would find more cause for complaint than to suggest that, in the face of 124 illustrations, there are still a number of useful illustrations, particularly of equipment, that might have been included to advantage. He would, however, find no fault with the proof-reading, format and typography, nor would his general impression be anything but favorable.

Colloid Chemistry

INORGANIC COLLOID CHEMISTRY. Vol. II. The Hydrous Oxides and Hydroxides. By *Harry Boyer Weiser.* 404 pp. Published by John Wiley & Sons, Inc., New York. Price, $4.75.

Reviewed by *Frederick E. Schmitt, Jr.*

WHEN THE WRITER had occasion, some months ago, to review Vol. 1 in this series, entitled "The Colloidal Elements," the plan of the series was not so evident. The appearance of the present volume indicates that the series will constitute a valuable contribution to technical literature. Notable in several ways, this book will be read by many. For one thing, the recently-developed technique of X-ray analysis of crystalline structures has been applied to the hydrous oxides and hydroxides. This book develops the evidence so produced by a number of workers into a critical evaluation of the exact structure of each compound, and by this means clarifies the distinctions between true hydroxides and hydrous oxides. At the same time, the recent and significant developments in inorganic colloid chemistry are summarized and interpreted in order of families. The book closes with four chapters on practical applications of the hydroxides and hydrous oxides, respectively, "Mordants," "Color Lakes," "Mineral Tanning," and "Coagulants in Water Purification." These serve to round out the presentation of data, and give a fitting closing to an informative volume.

Alloying Elements

EINFÜHRUNG IN DIE SONDERSTAHLKUNDE. By *Ed. Houdremont.* Verlag von Julius Springer, Berlin. 566 pages. Price, 52.50 Rm.

IN THIS extensive monograph on the alloy steels the author is giving principal attention to the physical and chemical properties of these alloys, and does not go into the metallurgical processes used in their production. The alloying elements discussed are nickel, chromium, tungsten, molybdenum, vanadium, cobalt, silicon, aluminum, copper, titanium, beryllium, boron, tantalum, columbium, zirconium, and cerium. Much space is given to the discussion of phase diagrams, beginning with the iron-carbon system, and taking up, under the various metals, the most common binary and ternary systems. The effect

of phosphorus and sulphur, and of gases, oxygen, nitrogen, and hydrogen is also discussed at great length.

Thorpe Up-to-date

THORPE'S DICTIONARY OF APPLIED CHEMISTRY. Supplement, Vol. II. By *J. F. Thorpe* and *M. A. Whitney*. Longmans, Green & Co., New York. 727 pages. Price, $25.

WITH the rapid advance of the science of chemistry and its application to industry during the past decade it has become necessary to bring the existing edition of Thorpe's Dictionary up to date by the preparation of three supplementary volumes. The first covers subjects up to and including the letter M; the second takes in the remainder of the alphabet, while a third volume, containing the glossary and a comprehensive index, will appear later in the year.

Last Word on Paints

SYMPOSIUM ON PAINT AND PAINT MATERIALS. American Society for Testing Materials, Philadelphia, Pa. 1935. 150 pages. Prices: cloth cover, $1.50; paper cover, $1.25.

THESE fifteen technical papers, with discussion, comprising the symposium on paint and paint materials, were presented at the A.S.T.M. regional meeting in March of this year. After a look into the future there is a paper dealing with the preparation, use and abuse of specifications, followed by discussion of protective and decorative coatings for railway passenger car equipment. Paint, varnish and lacquer testing are described and extensive papers follow on drying oils, zinc, lead and titanium pigments, mineral earth colors and synthetic iron oxides and chemical colors. Natural and synthetic resins; lacquer solvents and volatile thinners; and turpentine and petroleum distillates as thinners for varnish and paint, are covered in the three remaining papers.

Handling Carboys

CARBOYS, glass-boxed (I.C.C.1A)—Service requirements. Manual Sheet C-1. Manufacturing Chemists Association of the United States, Washington, D. C. 12 pages. Price, 25 cents.

CARBOYS, glass-boxed (I.C.C.1A), Handling and storing, when filled with or last containing any product authorized for shipment therein. Manual Sheet C-2. Manufacturing Chemists Association of the United States, Washington, D. C. 5 pages. Price, 10 cents.

THESE two recent contributions of the Technical Committees of the Manufacturing Chemists Association represent the last word of authority in connection with all carboy problems of chemical industry. Manual C-1, especially prepared for shippers of chemicals, covers the following subjects: Explosions, bursting, plant conditions, storage, handling, inspection, maintenance and testing, washing, filling, loading, and bracing of boxed filled carboys in less than carload and in carload lots, showing details and construction of bracing, loading of empty carboys in carload lots, together with 12 illustrations, including two full page cuts.

Manual C-2, especially prepared for consignees, covers the following subjects: Explosions, bursting, handling, special trucks to handle carboys, storage of filled carboys, opening, emptying, handling of empty boxed carboys, storage of empty carboys, loading empty boxed carboys in full carload lots, special precautions. 5 illustrations in this pamphlet.

Both pamphlets are stapled and punched for inclusion in the M.C.A. loose-leaf manual.

Introducing New Products

CHECK SHEETS: (1) Introduction of New Industrial Products. Market-Research Series No. 6, June, 1935. (2) Introduction of New Consumer Products. Market Research Series No. 7, By *O. C. Holleran*, U. S. Bureau of Foreign & Domestic Commerce, 75 pp. (Mimeographed) and 4 large check sheets. Price 5 cents for each bulletin.

THE INTRODUCTION of the new chemical product, whether intended for industrial or consumer market, is likely to prove a difficult and complicated process unless careful thought is given to many contributing factors. From the original inception of the idea through to successful production, consideration must be given to design, production and engineering factors as well as to costs, financing and capital investment. On the marketing side, studies are needed on buying habits, competition and pricing policies, distribution channels, sales promotion and management. None of these has been omitted in the helpful catechism of questions and suggested procedures which have been brought together in these two bulletins from the Marketing Research and Service Division of the Department of Commerce. They will be of value to any chemical executive—whether in production, research or sales—who faces the problem of introducing new products. And who doesn't?

HCl on Brick

DIE EINWIRKUNG VON SALZSÄURE AUF ZIEGELSTEINFASSADEN. By *E. Suenson*. Published by Danmarks Naturvidenskabelige Samfund, Copenhagen. 45 pages. Price, 5 Danish crowns.

FAILURE to the brick facing of certain buildings in Copenhagen was found to be caused by hydrochloric acid used for surface treatment which led to the formation of a mixed compound of oxide and chloride of calcium. This compound takes up 16 molecules of water of crystallization, and the resulting expansion causes the brick to crack and spall. To avoid this it is suggested to soak the brick with water prior to the treatment, thus preventing penetration of acid into the brick.

A.G.A. Proceedings

PROCEEDINGS OF THE SIXTEENTH ANNUAL CONVENTION OF AMERICAN GAS ASSOCIATION. Published by the Association, 420 Lexington Ave., New York City. 1,015 pages. Price, $3 to members and $7 to nonmembers.

THIS is the customary valuable résumé of the technical and economic proceedings of A.G.A., including much material not otherwise available anywhere in print. Every technical library pretending to treat any of the fuel industries should be supplied with this and the other numbers of the annual series of the proceedings.

Gas Directory

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES. Published by Robbins Publishing Co., New York City. 627 pages. Price, $20.

THE 1935 edition is the 48th annual issue of the widely recognized authoritative résumé of the manufactured and natural gas industry. It includes the customary details regarding city distributing companies, butane gas plants, holding companies, and other operating enterprises of the industry.

THE STRUCTURE OF CRYSTALS. Supplement for 1930-34 to the Second Edition. By *Ralph W. G. Wyckoff*. Reinhold Publishing Corp., New York. 240 pages. Price, $6.

ONE of the American Chemical Society's Monograph Series, presenting a summary of new determinations of X-ray structures which have appeared during the past four years. It follows strictly the form used in Part II of the second edition. In order to facilitate comparison the figure numbers and paragraph designations are continuations of those used in the main volume.

CHEMICAL ANALYSIS OF ALUMINUM. Published by Aluminum Research Laboratories, New Kensington, Pa. 83 pages. Price, 50 cents.

METHODS standardized and developed by the chemists of Aluminum Company

of America, under the direction of H. V. Churchill and R. W. Bridges are presented in attractive and comprehensive form in this very interesting booklet.

Process Industries Catalogued

CHEMICAL ENGINEERING CATALOG. Twentieth Annual Edition. Reinhold Publishing Corp., New York, 1935. 864 pages. Price, $10.

IT IS HEARTENING to find on examining the new Chemical Engineering Catalog an increase of more than 100 pages over the last edition. Whether this is due solely to increased confidence of manufacturers, or to a change in the type of copy admitted, or to both, is not evident. In any event, it points to reviving activity on the part of equipment and chemical producers and forges one more link in the chain of evidence that depression is on the wane.

From its flaming cover to its vivid advertising inserts, the catalog is new. Some among its users will doubtless approve the advent of rugged individualism in the use of color, special stock and non-uniform type of appeal. Others may regret the establishment of a precedent which will, perhaps, in a few years, lead far afield from the recommendation of the catalog committee of the sponsoring societies: namely, that advertisers adhere to the presentation of condensed catalog data, rather than "advertising" in the usual sense of the word. In the main this criterion is still being met. There is, however, a distinct possibility that in admitting display type advertising, the usefulness of the compilation as a reference book may eventually be impaired.

READERS' VIEWS

(Continued from page 562)

patent or not, unless compensation was forced by court mandate."

My prediction which is, of course, based on only a small fraction of the number of years experience of Mr. Chute, is that the industry will long outlive both Mr. Chute and myself. By adapting itself to acetic acid instead of acetate now, and to other new products and needs as conditions change, this industry will progress and profit even without the many advantages which may have been considered necessary in the past.

D. F. OTHMER.
Assistant Professor of Chemical Engineering, Polytechnic Institute, Brooklyn, N. Y.

Refers Acid Shipper To Recognized Channels

To the Editor of Chem. & Met.:

Sir—Reference is made to a letter appearing on page 507 of your September issue under the title "Acid Shipper Makes Suggestion," which is causing us much concern, for fear someone unfamiliar with the requirements of the Interstate Commerce Commission and the Association of American Railroads should fall for the recommendations made by your contributor.

If, as noted in connection with the letter referred to, it came from someone connected with an established chemical company in New York City, it is hoped that you can see your way clear to say that matters of this kind should be taken up through the recognized channels representing the industry, such as this Association, which has always worked in a cooperative way with the Bureau of Explosives, the Association of American Railroads and the Interstate Commerce Commission in matters of this kind.

Anyone familiar with the existence of at least the Federal requirements in this respect would, of course, hesitate in giving much credence to this article. The danger is in someone not knowing anything about the Regulations and transportation requirements thinking this idea were good.

You will be doing your readers a real service if you could induce them to avoid an embarrassing situation such as this in the future by advising them that intelligent progress can be made in perfecting and amending the I.C.C. Regulations by first presenting their criticism or suggestion to the existing organizations which specifically deal with such matters, such as the Bureau of Explosives, the Association of American Railroads and the Tank Car Committee of the Manufacturing Chemists' Association.

GEORGE E. TILEY.
Chairman, Tank Car Committee,
Manufacturing Chemists' Association,
Washington, D. C.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Synthetic Camphor. Tariff Commission, unnumbered document; mimeographed. Third investigation of the relation of synthetic camphor production in U. S. to consumption during six-month period ended June 17, 1935.

Suitability of Sweetpotato Starch for the Beater Sizing of Paper, by Charles G. Weber and others. Bureau of Standards, Miscellaneous Publication 150; 5 cents.

The Use of Carbon Disulphide Against the Japanese Beetle, by W. E. Fleming and F. E. Baker. Dept. of Agriculture Technical Bulletin 478; 10 cents.

Organic Sulphur Compounds Used as Insecticides, by R. C. Roark and R. L. Busbey. Bureau of Entomology and Plant Quarantine, unnumbered document; mimeographed. A descriptive list.

Selenium Occurrence in Certain Soils in the United States With a Discussion of Related Topics, by Horace G. Byers. Department of Agriculture, Technical Bulletin 482; 5 cents.

Crude Phosphates and Superphosphate. Tariff Commission Report No. 100, Second Series; 5 cents.

Reciprocal Trade Agreement Between the United States of America and Sweden. State Department, Executive Agreement Series No. 79; 5 cents.

Tariff Rules. Tariff Commission, Miscellaneous Series; 5 cents. Rules of practice and procedure for special investigations under recent laws. Revised to June, 1935.

Recent Developments in Dwelling Construction. Federal Housing Administration, Technical Report No. 1; mimeographed. Summarizes novel methods and novel materials, some of which are produced in chemical process industry. Revised Aug. 21, 1935.

Methylene Blue and Other Agents as Antidotes in Hydrocyanic Acid and Carbon Monoxide Poisoning, by George F. Cooper. From United States Naval Medical Bulletin, Vol. 33, No. 3.

Federal Alcohol Administration Act. Public Law 401. 74th Congress; 5 cents. Act to further protect the revenue derived from distilled spirits, wine, and malt beverages, to regulate interstate and foreign commerce, etc.

Purchasing Offices of the United States Government. Bureau of Foreign and Domestic Commerce, Machinery Division, unnumbered document; mimeographed.

General Rules and Regulations. National Labor Relations Board, Rules and Regulations Series 1; mimeographed.

Theoretical Metallurgy, by K. K. Kelley. Bureau of Mines Bulletin 383; 10 cents. Part III, The free energies of vaporization and vapor pressures of inorganic substances.

Carbonizing Properties and Constitution of Alma Bed Coal From Spruce River No. 4 Mine, Boone County, W. Va., by A. C. Fieldner and others. Bureau of Mines Technical Paper 562; 10 cents.

Limits of Inflammability of Diethyl Ether and Ethylene in Air and Oxygen, by G. W. Jones and others. Bureau of Mines Report of Investigations 3278; mimeographed.

The Ignition Temperatures of Diethyl Ether and Ethylene in Air and Oxygen, by G. W. Jones and others. Bureau of Mines Report of Investigations 3284; mimeographed.

Survey of Fuel Consumption at Refineries in 1934, by G. R. Hopkins. Bureau of Mines Report of Investigations 3281; mimeographed.

Active List of Permissible Explosives and Blasting Devices Approved Prior to July 31, 1935. Bureau of Mines Report of Investigations 3286; mimeographed.

A Procedure for the Removal and Determination of Small Amounts of Benzene in Biological Material, by W. P. Yant and others. Bureau of Mines Report of Investigations 3282; mimeographed.

News of EQUIPMENT

Cement Mill Equipment

For cooling cement clinker within at least 100 deg. of atmospheric temperature, the Traylor Engineering & Mfg. Co., Allentown, Pa., has introduced the Traylor-Cheesman rotary clinker cooler, which is a compact unit of the three-pass type. Air used for burning the kiln fuel is the cooling medium. This air travels counterflow with the clinker, and in intimate contact with the heat transfer elements. The cooler is completely enclosed and the loads distributed for minimum power consumption.

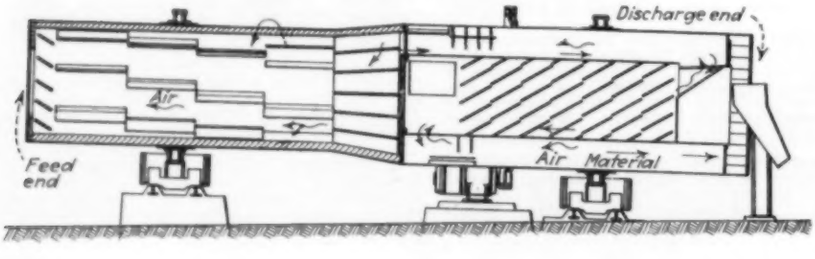
As it discharges from the kiln, the clinker is spouted into a brick-lined cylindrical chamber provided with lifters to shower the material, which then enters three of six flues formed in the annular space between the outer shell and the center tube at the lower end of the cooler. The clinker moves through these flues to the ends, at the discharge end of the cooler, where it is spouted into the center tube which is provided with spiral lifters to cause the clinker to move toward the feed end. At the forward end of this tube, the material is spouted into the other three, or "cold," flues in which it again moves towards the discharge end. Here it discharges into an annular trough supplied with lifter buckets which elevate it into a fixed discharge spout. The six flues are fitted with lifters and chains to hasten heat transfer between clinker and air. The interior of all flues is accessible from the discharge end of the cooler.

This company has also introduced a new burner for pulverized coal, gas or fuel oil. The burner employs all of the heated air from the clinker cooler, plus a smaller quantity of air direct from the atmosphere. The hot air is withdrawn from the connection between the kiln hood and the cooler, passed through an adjustable cyclone for removing clinker dust, and is blown by the same fan which draws air through the cooler into the burner. The burner is provided with adjustable devices for varying secondary and primary air blasts and the tip of the burner tube is adjustable to give any desired flame. At all times the operator has a clear view of the interior of the kiln, enabling him to make flame adjustments as required. Utilizing the cooling air at a temperature of 900 deg. F., or higher, the burner is stated to give a highly economical, luminous flame. In combination the burner and cooler are said to reduce fuel consumption per barrel of clinker by 100,000 to 400,000 B.t.u., at the same time increasing kiln capacity from 10 to 40 per cent. Incidental advantages claimed include 10 to 20 per cent reduction in energy for clinker grinding, and increase in life of the kiln lining. Cement color and uniformity are said to be improved and clinker handling simplified by reason of the lowered temperature.

Oilless Compressor

By eliminating metallic friction through the use of graphitic carbon supporting rings and segmental pressure rings also of carbon, the Ingersoll-Rand Co., Phillipsburg, N. J., has produced a new compressor for air or gas, known as the "ES-NL," which requires no lubrication within the cylinder. Hence there is no possibility of contaminating the air or gas with lubricants. This construction is possible because of the self-lubricating qualities of the carbon rings. The pressure rings are expanded by metallic inner rings so as to give the proper wall pressure.

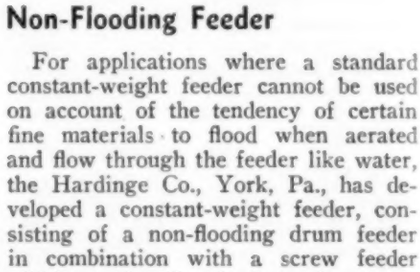
Cross-section of new cement cooler



Non-Flooding Feeder

For applications where a standard constant-weight feeder cannot be used on account of the tendency of certain fine materials to flood when aerated and flow through the feeder like water, the Hardinge Co., York, Pa., has developed a constant-weight feeder, consisting of a non-flooding drum feeder in combination with a screw feeder which continually checks and corrects the delivery of the drum feeder by weighing the discharge.

How this is accomplished is shown in the accompanying drawing. The drum feeder discharges to a screw feeder which is pivoted and counter-balanced so as to be horizontal when the correct weight of material is in the screw. Should the screw contain too little material, it tips upward at its right-hand end, closing a contact which operates a small motor, and this motor in turn increases the speed of the drum feeder. If the screw contains too much material, a contact is made which reverses the feed control motor, decreasing the speed of the drum feeder. When the correct delivery rate is reached, no contact is made and the drum feeder speed remains constant.



New non-flooding feeder

The new feeder is made in six sizes with screws from 4 to 24 in. in diameter, for delivering from 100 lb. to 300 tons of material per hour.

Self-Vulcanizing Rubber

"Self-Vulc" is the name of a pair of self-vulcanizing rubber compounds recently introduced by the Self-Vulcanizing Rubber Co., Room 512-J, 605 West Washington Blvd., Chicago, Ill. One of these compounds is a liquid and the other is a plastic material, both of which are used for producing rubber linings and coatings in equipment. Whichever compound is used, it is first necessary to coat the surface with one coat of a new priming compound supplied by the

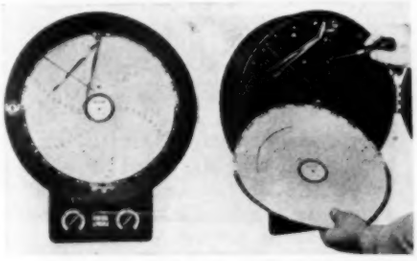
company. The liquid rubber compound may then be applied to the surface in any feasible manner such as brushing, spraying or dipping, after which it vulcanizes itself when exposed to the air. The plastic compound is applied over the priming by means of a spatula or other flat tool and similarly vulcanizes itself cold.

These products are recommended by the manufacturers for protection of both inside and outside surfaces, against abrasion, penetration of liquids or gases, and corrosion.

Air Operated Controllers

Brown Instrument Co., Philadelphia, Pa., has announced a new and complete line of air operated controllers, in both indicating and recording models, for temperature, flow, pressure and liquid level. These controllers are designed to take into consideration the fact that a great variety of conditions of lag and demand change are encountered in processes and that, on that account, varying degrees of correction for these conditions are required. There are, therefore, four general types of controller offered, the Air-O-Line, the Full Throttlor, the Throttlor and the On-and-Off.

In explaining the differences in the line it should first be mentioned that



Air-O-Line controller, showing adjustable features

with the conventional controller any change in demand will result in a slight shift in the point at which the instrument will control. To correct for this condition, the instrument must provide for "Reset." Some of the instruments do this automatically, while in others, the reset must be accomplished manually, as in conventional controllers. Process lag, further, introduces need for an additional correction. To prevent "hunting" in a process with long lag, the degree of control valve movement for unit pen travel must be small. For a process of lower lag, the valve movement, in relation to pen travel, should be greater. Three of the four instruments of the line, therefore, provide for varying this relation, or "throttling range."

Air-O-Line controllers correct for the magnitude, rate and direction of shifts from the control point, providing both automatic reset and adjustable throttling range from 1 to 150 per cent. Full Throttlors are equipped with manual reset and adjustable throttling range. Throttlors have manual reset with 1 to 10 per cent throttling range adjustment, while the on-and-off line gives two-position control at whatever control point may be set. Control units of the first two are hermetically sealed and are interchangeable. Control units of the last two are similarly interchangeable.

Temperature controllers are made in both thermometer and potentiometer types, depending on the temperature range. Flow and level controllers are made in both inductance bridge and mechanical types.

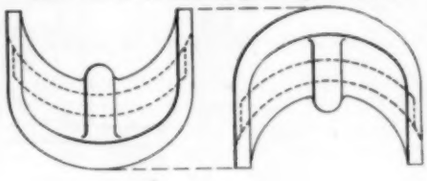
Saddle Packing Material

Maurice A. Knight, Kelly Ave., Akron, Ohio, has announced the introduction of a new tower packing unit made of chemical stoneware which is said to give the largest possible surface per unit of volume as well as minimum resistance to the flow of gases or liquids through the tower. This packing unit, developed by Dr. Ernst Berl of Carnegie Institute of Technology, closely resembles a saddle, from which the packing takes its name. It is based on a mathematically determined shape, calculated to give optimum conditions for contact between gases and liquids. The accompanying sketch shows two views of one of the new packing units, taken 90 deg. apart.

Saddle packing, at present, is available only in the 1-in. size. In this size the packing, when arranged irregularly in the tower, gives an average of 2,260 sq.ft. of surface per cubic foot. The packing occupies 25 per cent of the packed volume and weighs 53 lb. per cu.ft. Advantages of the new material, other than those mentioned, include an interlocking effect which results in small side pressure on the tower; avoidance of channel formation; and an angle of distribution with center feeding of the liquid of 55 to 60 deg.

Saddle packing, it is stated, is equally satisfactory for heat transfer uses, distillation columns, absorption towers and extraction columns. Because of the large angle of distribution, low towers of large cross-section may be used. The required packed volume is said to be

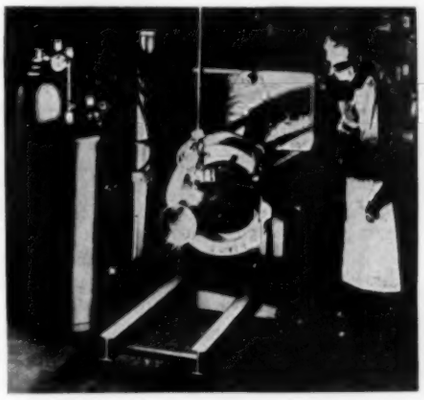
Two views of saddle packing material



less than with other packings because of the intimacy of contact obtainable and the large area per cu.ft. The low resistance, as compared with other packings, is said to decrease power consumption materially. For example, in the 1-in. size, as compared with 1-in. ring packing, the energy saving for moving the gases is said to amount to over $75 per year at 2 cents per kw.-hr.

Pipe Cutter

What is said to be a totally new idea in pipe cutting equipment is the new No. 212 machine recently introduced by Oster-Williams, 2057 East 61st Place, Cleveland, Ohio, for cutting pipe intersections. Without using cams, templates or special fixtures, and without laying out the job, any sort of cut in the end of the pipe may be made, in pipes ranging from 2½ to 12 in. in size, for the fabrication of elbows, tees,



New pipe cutting machine in operation

reducing tees, miters, Y's and other shapes.

The machine employs a cutting torch which is guided by an ingenious mechanism duplicating the results formerly obtained, it is said, only by skilled hand labor. A chart is furnished which guides the operator in setting the machine for any type of cut. Even the most difficult cut requires only five simple settings, according to the manufacturer.

Equipment Briefs

In order to secure both high strength and corrosion resistance, the Huntington Works of the International Nickel Co., Huntington, W. Va., has developed a new alloy closely resembling Monel metal, the chief difference being in the addition of aluminum. The new alloy, known as K Monel, can be hardened by heat treatment and is produced in four different grades of hardness with Brinel values ranging upward to 325 and tensile strength as high as 160,000 lb. per sq.in. The material is available in

a variety of forms including forgings, rod, strip and wire.

A new vacuum power switch for use where explosion hazards exist, where rapid contacting is desired, or where long switch life is necessary, has been introduced by the Continental Electric Co., St. Charles, Ill. The new switch is of the mercury contact type, but operates in a high vacuum chamber by means of a solenoid, without the use of rotating or tilting devices. The maximum rating is 2 kva. and the switch is obtainable in two models, one with the contact normally opened, and the other with the contact normally closed.

Variations in speed as high as 15 to 25 per cent per sheave can be made by means of a simple adjustment of the pitch diameter of a new Texrope sheave recently introduced by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The Vari-Pitch sheave is made in two multi-groove types. In one the adjustment is made while the sheave is stationary; in the other, changes are made while the drive is in operation.

Lea Mfg. Co., Waterbury, Conn., has introduced a new acid ejector for emptying carboys without the necessity of lifting or tilting the carboy. The equipment consists of a siphon which is quickly secured in the neck of the carboy by means of a rubber seal. A small portable electric-motor-powered compressor is then used to apply sufficient air pressure over the surface of the acid to cause flow from the siphon.

American Optical Co., Southbridge, Mass., has announced the development of a new goggle which is similar to the company's Ful-Vue spectacles in appearance. The ear-pieces are of flexible cable, completely insulated from the skin. Nose-pads are employed instead of the customary nose-piece. The domed lenses are said to be capable of withstanding blows approximately twice as heavy as those which fracture standard lenses.

A tubular case Rotameter for measuring flow of gases or liquids at low pressure has recently been added to its flowmeter line by Schutte & Koerting Co., Philadelphia, Pa. The new flow rate indicator is similar in principle to other meters of this line. It has been designed for simplicity and low cost and is available in sizes from 1 to 4 in. for installation in vertical runs of pipe.

Amco Metallic Coatings, products of the American Solder & Flux Co., Wayne Ave. and Berkley St., Philadelphia, Pa., which were formerly supplied as separate metal and flux, are now furnished in powdered form requiring only the addition of water before use. The solution is applied to the metal surface to be coated and is heated to the melting point of the coating. Zinc, tin and lead coatings are available.

For pressures to 300 lb. per sq.in. and temperatures to 650 deg. F., Worthington Pump & Machinery Corp., Harrison, N. J., has now developed a complete line of heavy-duty rotary pumps for handling practically any kind of clean liquid at any temperature. Both standard and steam-jacketed pumps are available with capacities from 10 to 2,500 g.p.m. These pumps are of the continuous-tooth double-helical gear type, mounted on heavy shafts with large, high-capacity bearings.

Positive Variable Speed Transmission

Positive transmission of power and infinitely variable speed delivery over its entire range are features of a new variable speed transmission, the Transitorq, recently announced by the New Departure Mfg. Co., Bristol, Conn. In this mechanism hardened steel rollers in pressure contact with equally hard steel races are utilized to transmit power. An automatic device employs the imposed torque load itself to generate the required pressure between the rollers and races. This feature is said to be so sensitive that it responds immediately and proportionately to every change in load.

The accompanying cross-sectional view shows the principal elements of the transmission. The rollers, of which there are three, are mounted in a floating, non-rotating spider. Each roller can rotate on its own axis and can also be rocked a limited distance about an axis at right angles to it. Hence, the rollers may be adjusted to any position relative to the races from the lowest to the highest speed ratio positions indicated on the drawing, and thus transmit to the output race any speed within this range.

Automatic control of roller contact pressure is secured through the use of a pair of torque loading flanges separated by three balls equally spaced in inclined grooves. One of these flanges is stationary and the other floats in engagement, through a set of fingers, with the roller spider. The driving force applied to the rollers tends to rotate the spider, which in turn tends to rotate the floating torque flange. Such slight rotation, through the cam action of the inclined grooves, causes an axial displacement of the floating flange which is communicated through an annular contact ball bearing to the output race, resulting in increased pressure between rollers and races which is proportional to the load.

A further feature of the transmission is the method of speed adjustment. Any desired ratio may be set manually or by remote control on a calibrated dial. A device operated hydraulically under pressure from a built-in pump maintains the roller adjustment at the highest ratio consistent with the dial setting. When the transmission is shut down, however, the loss of hydraulic pressure causes the mechanism to return to the lowest ratio setting so that when a new start is made, the load will be accelerated at an adjustable rate from the low-speed, high-torque position to the ratio called for by the dial setting.

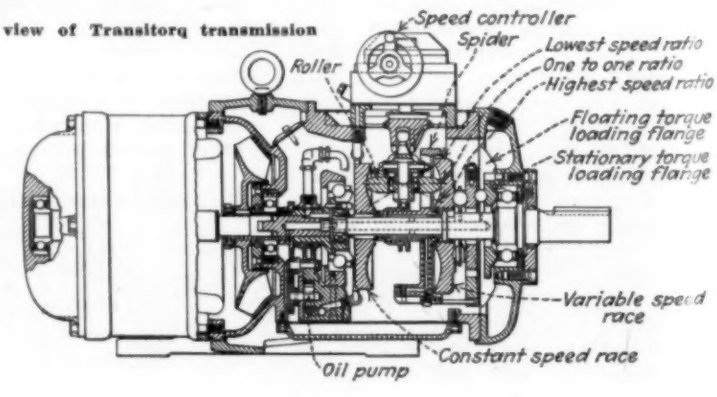
Transmissions are at present built in six sizes for ratios of 6 to 1 or 10 to 1, to transmit from ¼ to 15 hp.

Insulating Concrete

A heat insulating material with a heat-transfer coefficient comparable to cork may be produced from portland cement, with or without the addition of mineralized wood fiber, by a process developed by the Porete Mfg. Co., North Arlington, N. J. This product, known as Poretherm is usually made in one of two weights, either 19 or 32 lb. per cu.ft.. It can be made in precast shapes, in the form of slabs and blocks, or it may be poured in the field. The 19-lb. material is used for insulating refrigerated spaces and for high temperatures up to 700 deg. F. Its crushing strength is 40 lb. per sq.in. The 32-lb. material is used for ordinary insulating and for fireproofing steel structural members. Its crushing strength is 150 to 200 lb. per sq.in.

This material is mixed in an ordinary

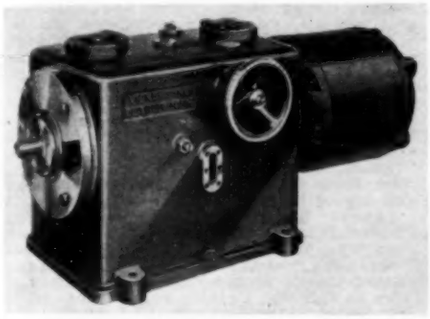
Sectional view of Transitorq transmission



concrete mixer, using portland cement and water to which Porete foaming agent is added. Without chemical action air is whipped into the mixture to form a concrete containing great numbers of small air bubbles. For the 19-lb. material the coefficient of heat conductivity is 0.37 and for the 32-lb. material, 0.63 B.t.u., as compared with 0.30 for cork board.

Hydraulic Transmission

Any desired speed between 5 and 750 r.p.m. may be secured at the turn of a hand-wheel through the use of a new hydraulic variable-speed transmission recently announced by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. The transmission has no exposed working



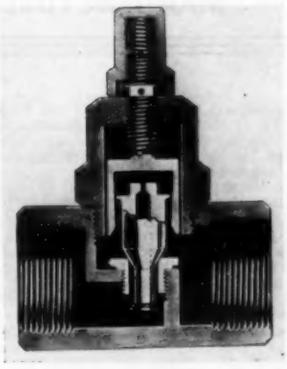
Hydraulic variable-speed transmission

parts or piping and consists of a multiple-piston fluid pump direct connected to a 1,200-r.p.m. motor which in turn drives an hydraulic motor. The size at present available has a maximum output of 6 hp. for continuous duty or 7½ hp. for intermittent service.

Impulse Steam Trap

A new steam trap which is hardly larger than a pipe union and which has only one moving part has recently been introduced by Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa. The new trap depends for its operation on the difference in flow characteristics of cold water, hot water and live steam, flowing through two orifices with a chamber between. The valve disk, shown in the sectional view, moves under variations in pressure in the space above the valve. The valve opens fully when cold water is to be discharged. When the condensate approaches steam temperature, however, flashing takes place in the control orifice, causing the valve to close.

Valve, piston and orifice are proportioned to give positive opening of the valve when cold condensate collects and quick closing when the pipe system becomes hot. The trap is said to operate without adjustment, in any application, at all pressures from 0 to 400 lb., with-

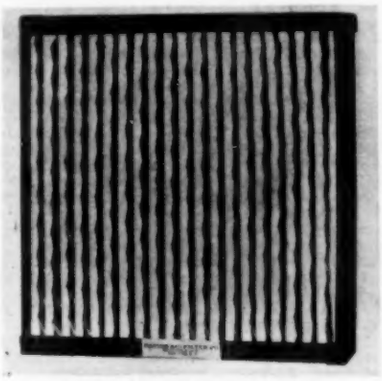


Sectional view of impulse trap

out the possibility of air-binding and without need for priming. It is made in six sizes, ranging from ½ to 2 in.

Replaceable Air Filter

A dry-type, throwaway air filter which contains a filtering area of 30 sq. ft. in a cartridge 20x20x4 in. in size is the new Airplex filter made by the Davies Air Filter Corp., 390 Fourth Ave., New York City. The filtering medium is a specially processed cotton fabric, folded into 4-in. pleats which are separated by means of corrugated cardboard spacers. The material, which is treated to be resistant to fire, is suitable for operation at temperatures between minus 32 and 200 deg. F. For air velocities not greater than 26 ft. per minute with dust particles of 10 microns



Renewable air-filter cartridge

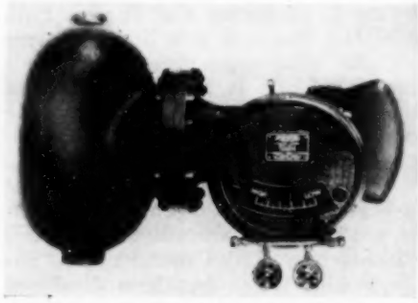
or larger, the efficiency is said to be over 98 per cent. The average life of one of these filters is said to be two to three months and the normal rating is 800 c.f.m. per unit.

Industrial Cooling Towers

A new line of induced-draft cooling towers with cooling capacities ranging from 5 to 200 g.p.m. has been announced by the Binks Mfg. Co., 3114 Carroll Ave., Chicago, Ill. These towers are used for producing cooling water for refrigeration, for internal combustion engine jackets and for other purposes. Water distribution is obtained with this company's low-pressure Rotojet nozzles which deliver water as a finely atomized mist downward through an upward current of air induced by the fan assembly at the top of the tower.

Level Controller

The Foxboro Co., Foxboro, Mass., has announced the application of its Stabilog system of control to a new type liquid-level control instrument employing a specially designed, friction-free, ball-float mechanism. The ball float may be installed inside the vessel, the level of which is to be controlled, or



New float-operated level controller

outside within a kidney type float chamber. It is claimed that these controllers will maintain the level in a chamber within safe limits and at the same time give a smooth outflow without creating upsetting surges.

Equipment Briefs

Capacities up to 400 g.p.m. and heads from 400 to 1,600 ft. are possible with the new type MM multi-stage centrifugal pump recently announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This pump is of the horizontal split-casing, double-suction type, bronze-fitted and designed for maximum practical regain of pressure between stages.

Philadelphia Drying Machinery Co., Philadelphia, Pa., has recently developed a new proportional mixer for use in connection with gas burners. To insure maintaining the predetermined gas-air ratio at any rate of firing, regardless of variation in gas pressure, the device employs a "zero governor" which is a diaphragm-actuated control valve feeding gas at atmospheric pressure to an inspirator into which the gas is drawn and mixed with air. The amount of gas inspirated, therefore, is directly proportional to the quantity of air flowing through the inspirator. The proportionality is adjustable.

For the industrial determination of

surface temperatures, as of motors and bearings, the Ideal Commutator Dresser Co., Sycamore, Ill., has introduced a new bimetallic thermometer known as the Ideal Tel-Temp. The thermometer is easily and quickly attached to the motor or other machine, and indicates operating temperature at a glance.

Alemite Division of Stewart-Warner Corp., Chicago, Ill., has announced a high-pressure, air-operated barrel pump, with the designation HP-100, which converts any original 100 lb. lubricant container into an efficient power gun for industrial lubrication. A low-pressure pump carries a continuous flow of lubricant from the container to a high-pressure pump delivering at a pressure 33 times that of the air-supply. Depending on the type of lubricant, delivery per minute ranges from 18 to 6½ oz.

Complete oil resistance is accredited by the L. H. Gilmer Co., Tacony, Philadelphia, Pa., to a new line of V-type and flat belts which has recently been introduced. It is stated that belts of this type have already been run for long periods immersed in oil, without injurious effect.

Cast iron with an ultimate tensile strength of 35,000 lb. per sq. in. is employed by the Walworth Co., 60 East 42d St., New York City, in a new "Hi-Test" pipe which has been developed for water and gas lines for service conditions precluding the satisfactory use of steel or wrought iron. The new pipe is supplied in sizes of 1¼ to 6 in. diameter and 5 to 20 ft. lengths and is intended for water working pressures to 175 lb. per sq. in.

Two methods of applying metallic boron crystals to the surface of metals for the production of wear- and corrosion-resistant surfaces have been developed by Colmonoy, Inc., Los Nietos, Calif. The "sweating-on" method mixes the crystals with sodium silicate to form a stiff paste which is then coated over a surface to be processed. Sufficient heat is applied with a torch or arc to sink the crystals into the parent metal. The second method, the "cast-on" process, employs a mixture of crystals in a matrix of nickel alloy with a lower melting point than steel which is melted and poured on the surface, within a mold. The overlay fuses securely to the parent metal.

A stainless steel valve disk and seat ring, hardened to 500 Brinell, and said to prevent wire drawing, steam cutting and galling, are important features of a new union-bonnet, bronze globe valve that has been developed by the Hancock Valve Division of Consolidated Ashcroft Hancock Co., Bridgeport, Conn. The valve is designed for easy repacking under pressure and is built in globe and angle patterns for pressures to 300 lb.

MANUFACTURERS' LATEST PUBLICATIONS

Centrifugals. American Tool & Machine Co., 1413 Hyde Park Ave., Boston, Mass.—6-page leaflet describing recently developed features in belt driven centrifugals. Also 4-page leaflet on this company's centrifugal baskets, describing construction and tests.

Electrical Equipment. Crouse-Hinds Co., Syracuse, N. Y.—Leaflet announcing Catalog No. 2500 which will shortly be available as this company's most complete catalog on Condulets.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-246D, High-speed synchronous motors; GEA-1427B, 8 pages on time switches; GEA-2177, Power Selsyns.

Equipment. Paul O. Abbé, Inc., Little Falls, N. J.—8-page condensed catalog describing this company's line of ball and pebble mills and mixers for laboratory and production use.

Equipment. Combustion Engineering Co., 200 Madison Ave., New York City—4-page leaflet describing this company's services in production of pressure vessels and fabricated platework; also two other 4-page folders, one describing stoker units for boilers to 400 hp., the other briefly illustrating all types of boilers and fuel systems furnished by this company.

Equipment. Worthington Pump & Machinery Corp., Harrison, N. J.—W-210-B17—4 pages on deaerating feedwater heaters; also W-450-B24, 4 pages on deep-well pumps.

Furnaces. Ajax Electrothermic Corp., Ajax Park, Trenton, N. J.—Bulletin 9—4-page bulletin describing this company's small laboratory furnaces.

Gaskets. Goetze Gasket & Packing Co., New Brunswick, N. J.—Catalog 48—64 pages with engineering data and price lists on metallic and semi-metallic gaskets, sheet and stuffing box packings, sealing compounds and accessories.

Heat Exchangers. Griscom-Russell Co., 285 Madison Ave., New York City—Bulletin 1620—12 pages describing and giving application data on this company's "Tube-Flo" sections.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 8900—24 pages describing this company's complete new line of air-operated controllers for temperature, pressure, flow and liquid level.

Insulation. Johns-Manville, 22 East 40th St., New York City—48-page catalog on this company's industrial products including insulation, packing, refractories, piping and other materials.

Koroseal. B. F. Goodrich Co., Mechanical Rubber Goods Division, Akron, Ohio—12-page booklet describing properties of Koroseal synthetic rubber-like material, listing forms available, and successful uses.

Maintenance. Stonhard Co., 401 North Broad St., Philadelphia, Pa.—24-page booklet on methods of keeping floors, roofs, walls and foundations in good repair.

Materials. Continental Diamond Fibre Co., Newark, Del. 46-page catalog describing properties and uses of Dilecto laminated phenolic materials, available in form of sheets, rods and tubes.

Materials. Synthane Corp., Oaks, Pa.—Leaflet describing uses of this company's laminated Bakelite, also discussing physical and chemical properties.

Materials Handling. Standard Conveyor Co., North St. Paul, Minn.—Publications as follows: 40-page general catalog, "Conveyors by Standard"; 56-page detailed catalog on gravity roller conveyors; 56-page detailed catalog on pneumatic tube systems.

Metals and Alloys. Bethlehem Steel Co., Bethlehem, Pa.—Catalog 107—367 pages on this company's alloy steels, covering grades, uses, testing, properties, working, etc.; also defines common terms and lists useful information; also Bulletin 54-B, 24 pages on silvery Mayari alloy iron and Booklet 88, 16 pages on physical properties of seven types of alloy steels.

Metals and Alloys. Chemical Foundation, Inc., 654 Madison Ave., New York City—47 pages on the uses of stainless steels, listing also licensees of this organization.

Mixers. Read Machinery Co., York, Pa. Folder describing laboratory and production mixers for mixing of doughs, high and low viscosity liquids and dangerous chemicals.

Mixing. Struthers-Wells Co., Warren, Pa.—Bulletin 13—16 pages describing this company's mixers, autoclaves and agitators.

Porous Mediums. Norton Co., Worcester, Mass.—Form 1246—20 pages on the use of this company's porous plates and tubes in sewage treatment.

Power Transmission. Manhattan Rubber Manufacturing Division, Raybestos-Manhattan, Inc., Passaic, N. J.—Bulletin 6808-B—4 pages describing this company's compensated transmission belting; also Bulletin 6840, 4 pages on the construction of this company's V-belts.

Power Transmission. Reeves Pulley Co., Columbus, Ind.—112-page speed-control handbook covering many phases of speed control, with particular reference to the design, construction and application of the variable speed transmissions and accessory equipment made by this company.

Pulverizing. Pulverizing Machinery Co., 126 Valley Rd., Roselle Park, N. J.—4-page temporary bulletin describing this company's pulverizers for laboratory, pilot plant and small production work.

Pumps. Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass.—Bulletins 205 and 206—Respectively describing paper stock pumps and non-clogging sewage and sludge centrifugal pumps.

Pumps. Westco Pump Corp., Davenport, Ia.—Form 688—4 pages describing a close-coupled, motor-driven turbine pump made by this company.

Refractories. Norton Co., Worcester, Mass.—Form 863—8 pages on refractory cements of three types, based on fused alumina, silicon carbide and magnesia.

Roofs. Johns-Manville, 22 East 40th St., New York City—24 pages on construction and use of built-up roofs in industry.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletin DK-3—4 pages describing molded hats for head protection.

Screening. Audubon Wire Cloth Corp., Castor Ave., Philadelphia, Pa.—Publications as follows: Catalog 40, 56 pages with list prices, specifications and useful information on this company's complete line of wire cloth; No. 41, 16-page excerpt of general catalog section on flexible wire cloth; Catalog 42, 8-page condensed version of general catalog.

Screens. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1474-A—8 pages describing this company's line of Aero-Vibe vibrating screens.

Sound Insulation. Johns-Manville, 22 East 40th St., New York City—Bulletin DS Series 275—16-page bulletin on sound control of mechanical equipment, describing the use of sound dampening and absorbing materials and vibration isolating mechanisms.

Thiokol. Thiokol Corp., Yardville, N. J.—Leaflet announcing a new synthetic rubber coating material known as Thiokol C-103.

Traps. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Circular T-1720—Folder describing this company's new line of Impulse steam traps.

Tubing. Parker Appliance Co., Cleveland, Ohio—Bulletin 40—24 pages on tube fabricating equipment, giving instructions and price lists and describing this company's fabricating service.

Unit Heaters. The Trane Co., LaCrosse, Wis.—26-page catalog describing this company's recently improved line of unit heaters.

Valves. Consolidated Ashcroft Hancock Co., Bridgeport, Conn.—8-page booklet describing a new union-bonnet bronze valve made by this company; 4 pages covering this company's new Flocontrol valve.

Welding. American Manganese Steel Co., Chicago Heights, Ill.—6-page leaflet on this company's hard-facing welding rods.

Welding. Harnischfeger Corp., Milwaukee, Wis.—Bulletin HW-4—24 pages covering this company's line of arc welders, including 50-800 amp. units; also describes welding fixtures and accessories.

Welding. Lincoln Electric Co., Cleveland, Ohio—36-page catalog on arc welding electrodes, describing uses of numerous types; also covers welding accessories. Welder Specification Bulletins 309 and 310 cover respectively specifications on 200 and 300 amp. gasoline-engine-driven arc welders.

Welding. Wilson Welder & Metals Co., P. O. Box 96, North Bergen, N. J.—30 pages on a comprehensive line of welding electrodes offered by this company.

Your Plant NOTEBOOK

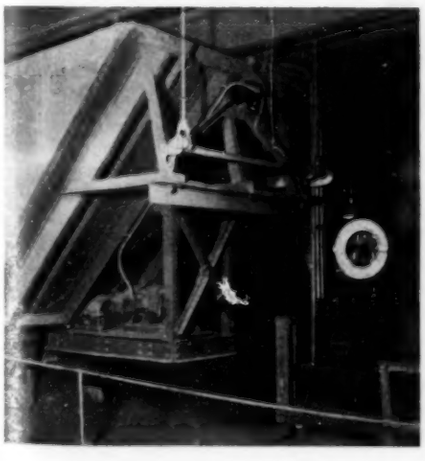
Photoelectric Scales in Process Weighing

PHOTOELECTRIC cells applied to weighing have recently become an important factor in process operations. An installation completed not long ago at the Steubenville, Ohio, plant of the Wheeling Steel Corp. serves to illustrate the use of such equipment and may prove suggestive to engineers in other process industries.

In this plant previous practice had been to weigh the ore and flux fed to the blast furnace into a scale-equipped gathering car, but to measure the coke volumetrically. In the new setup a hopper of about 200 cu.ft. capacity is suspended from a special lever system connected to a Toledo dial scale equipped with a photoelectric cell and light source. The hopper is filled by a motor-driven feeder which removes the breeze from the coke as it feeds. The feeder motor is magnetically braked and is arranged to be shut off automatically when the light beam to the photoelectric cell is intercepted at the instant the desired weight of coke has entered the hopper. A duplicate weigh hopper is provided and both hoppers discharge through motor-operated gates to the skip pit.

Feeding of the coke to the skip car is controlled by an automatic interlock in the following fashion. When the skip car reaches its loading position it receives a charge of material and travels to the top of the furnace. This is repeated a second and third time, but on the fourth and fifth trips the gate of one of the coke hoppers opens automatically and coke feeds to the car. As soon as the operator sends the car up, the dump gate shuts and the coke weighing operation starts, both under automatic control. The quantity of coke charged is recorded and checked by a printing attachment on the scale which records each load and by a counter showing the number of times the gate has opened.

Scale with photoelectric cell controlling weigh hopper for coke



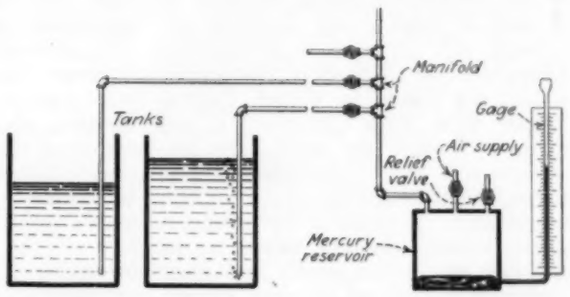
Centralized Measuring System For Liquids in Tanks

By W. S. Gilfoil
Lake Providence, La.

A METHOD of measuring liquid depths hydrostatically was described by Brennan in the November, 1928, issue of *Chem. & Met.* (reprinted in Chemical Engineer's Plant Notebook, p. 101, 1933). This method proposed to use a small mercury-sealed, hand-operated pump to supply air to the measuring pipe and depth-indicating manometer. In an installation which improved, I believe, on Brennan's method a single centralized hydrostatic system was employed in measuring the depth of lubricating oils of different specific gravities contained in more than 20 tanks of 7 to 40 ft. height.

The improved method substituted the plant compressed air supply for the hand-operated pump and provided a manifold by which any one of a group of tanks could be connected to the manometer. The hookup and manometer are shown in the accompanying drawing, with the size of the manometer very much exaggerated in relation to that of the two tanks. For tall tanks, or a combination of tall and short tanks, the liquid in the manometer had best be mercury so that the necessary height of measuring column will be within reason. For example, a 3-ft. mercury column was suitable for the 40 ft. tanks in the installation mentioned. For sufficient accuracy of reading with a mercury column it is desirable to use a vernier,

Centralized hydrostatic pressure system for measuring liquid depth



with which the column can be read to a precision of 0.01 in. of mercury. If the depth of tank is not so great as to make the length of liquid column impractical, a much lighter manometer fluid may be used, such as water, in which case no vernier is necessary.

The apparatus is not difficult to use. First the valve connecting with the particular tank to be gaged is opened and the relief valve closed. The latter valve is used to bring the manometer to atmospheric pressure after any measurement and to insure against blowing the mercury out of the manometer should the air valve be accidently opened or should it develop a leak when all of the tank valves are closed. Then the needle valve on the air supply is opened, permitting air to enter the apparatus. As soon as a pressure has been built up equal to the hydrostatic head of liquid in the tank, air will bubble up through the tank from the bottom of the measuring pipe and the mercury column in the manometer gage glass will reach a standstill. Any single tank may be connected to the manometer and air supply as long as desired but the relief valve should be opened as soon as the tank is disconnected.

In the article mentioned, Brennan described the use of a variety of mercury seals to prevent the entrance of the tank liquid into the measuring pipe. Any type of seal may be used with the practical exception that, where a light liquid is employed for the manometer, a seal developing no back pressure, such as Brennan's type *b*, is necessary to avoid an impractical length of liquid column.

Chemical Engineering NEWS

Chemical Show Will Offer Industrial Pageant

THE greatest industrial pageant of chemical achievement since the depression will be on view at the 15th Exposition of Chemical Industries, which will open in Grand Central Palace, New York, December 2 and continue through that week. The Exposition will be a presentation of materials, products, and machines. It will tell its story in terms of the strongest senses, namely, through appeal to the eye and ear. Semi-works and plant equipment for all of the unit process industries will be graphically demonstrated. The visitors can see actually the chemicals themselves, study machines in operation, and in some cases, witness the production and packaging of the finished product.

The Exposition this year is divided into the following classifications: chemicals and chemical products; plastics, molded products, and lacquers; laboratory equipment and supplies; general equipment; instruments of precision; containers and packaging equipment; brewing, distilling, and bottling equipment; materials handling equipment; raw materials, natural resources and industrial opportunities; and educational exhibits.

Virtually the same number of modern synthetic plastics as last time will be exhibited, but novelty will be revealed in terms of their application. The phenol-formaldehyde-asbestos type of plastic will be represented not only in the small part molding sense, but in terms of plant equipment, such as large tanks, hydrochloric acid absorption towers, and industrial piping. For general purposes there will be metal tanks, rubber lined and glass lined, and the field of glass as a material for piping and lining unit apparatus in chemical engineering will be seen to have advanced. In the field of chemical stoneware there will be tendency toward structural design improvement with increased speed of operating parts. Shown also will be the rôle of silicates, including sodium metasilicate and sodium sesquisilicate.

The field of prepared special gases for the process industries will range in application from fruit ripening to municipal sanitation. A large explosives manufacturer will feature the peace-time triumphs of organic research. This exhibit will feature new water emulsion lacquers, chlorinated rubber paint base, a new rosin compound for synthetic plastics and ethyl cellulose for use as a plastic. Detergents will include those for general cleaning and laundering with specialties for use in metal working plants. Metals and alloys will be the subject of a number of exhibits. The metals exhibited will range from iron and steel through nickel, copper, brass, and all of the industrial alloys to the more precious metals like platinum and rhodium, including an exhibit of rhodium electroplating. There will be a display of rhodium-platinum laboratory apparatus, platinum ware and rhodium-plated silver ware. Tantalum will be the subject of an exhibit pertinent to new laboratory and plant applications. The development of seamless tantalum tubing during the past year is said to have made it possible to utilize the corrosion resisting characteristics of this metal in a greatly widened field.

The section devoted to instruments of precision will include the latest in laboratory balances, gas analysis sets, titration equipment, and hydrogen ion measurement systems. The indicating and recording meters will demonstrate the recording and control of any process in terms of all the physical constants such as temperature, pressure, humidity. The control and recording of operations at long distances will be featured.

Paint Men Will Convene In Washington

A THREE-DAY convention of the National Paint, Varnish and Lacquer Association will open at the Mayflower Hotel, Washington, D. C., on Oct. 28. The annual convention of the Federation of Paint and Varnish Production Clubs also will be held at the Mayflower on Oct. 27-29.

The Association meeting will open with addresses and committee reports on the morning of Oct. 30 followed by a trade sales conference in the afternoon. On Oct. 31 an industrial sales conference is scheduled for the morning and a combined industrial and trade sales conference for the afternoon. The final business session will be held on Nov. 1 at which session officers for the ensuing year will be elected.

The production men will open their meeting on Sunday afternoon, Oct. 27, with business sessions continuing through the next two days. Coincident with this meeting will be the Paint Show which has come to be an important feature of the annual production clubs meetings.

Diphenyl Patent Suit Won by Dow

THE Dow Chemical Co. won the suit brought by the Monsanto Chemical Co. and Swann Research Co. of Birmingham, Ala., in which patent infringements were alleged, when Federal Judge Arthur J. Tuttle sitting at Bay City, Mich., held the patents were void and lacking in invention. The suit was dismissed. It was claimed by Monsanto that processes for producing diphenyl by preheating and sudden cooling were covered by their patent and that a second patent covering the putting of benzol vapors through tubes "rapidly and at a turbulent flow" had been infringed upon. The court held that "these patents, if they have any validity at all, are broad and basic. . . . The things described in these two patents are so basic, and broad and far reaching and fundamental that no one is ever going to be, during the life of these patents, able to make any diphenyl on a large scale without infringing the language of these patents if interpreted the way it is intended."

New Canadian Laboratory For Metal Research

A REPORT from H. M. Bankhead, commercial attache at Ottawa, states that recent press announcements have credited the International Nickel Co. of Canada with approving plans for the construction of a research laboratory at Copper Cliff, Ontario. The laboratory will resemble in many respects that at Bayonne, N. J., and the one now being constructed in Birmingham, England. The announcement states that the plant will deal with projects leading to improvements in the processes for refining nickel and copper, with particular emphasis towards the development of new uses for copper. Prior to this expansion the entire output of copper was treated in an electrolytic refinery at Copper Cliff.

A.I.Ch.E. Will Hold Annual Meeting in Columbus

THE twenty-eighth annual meeting of the American Institute of Chemical Engineers will be held at Columbus, Ohio, on Nov. 13-15 with the Deshler-Wallick Hotel as official headquarters. Morning meetings for the three days will be devoted to presentation and discussion of technical papers on applied chemical engineering subjects. The first two afternoon sessions will be given over to inspection of chemical plants of Columbus and Central Ohio. On Friday, Nov. 15, both morning and afternoon sessions will be devoted to discussions on principles of chemical engineering. A group luncheon will follow each morning technical session and on the evening of Nov. 13 an informal dinner will be held followed by entertainment. On the following evening the annual banquet will take place.

The following papers have been tentatively scheduled for presentation at the technical sessions:

"Fluid Flow in Clean Round Straight Pipe—I—The vonKarman Number II Commercial Steel Pipe Lines," Benjamin Miller.

"The Conditions for Drop-Wise Condensation of Steam," T. B. Drew, W. M. Nagle and W. Q. Smith.

"Heat Transfer Coefficients During Drop-Wise Condensation of Steam," W. M. Nagle, G. S. Bays, L. M. Blenderman and T. B. Drew.

"The Influence of Small Concentration of Air in Steam on the Steam Film Coefficient of Heat Transfer," S. J. Meisenburg, R. M. Boarts and W. L. Badger.

"Capacity of a Spray Type Countercurrent Solvent Extraction Column Applied to the Mass Transfer of Acetic Acid Between Water and Isopropyl Ether," J. C. Elgin and F. M. Browning.

"Separation of Solvents and Water in Refining and Dewaxing of Lubricating Oils," E. R. Smoley and W. W. Kraft.

"Equilibrium Absorption of Carbon Dioxide by Solutions of the Ethanolamines," J. W. Mason and B. F. Dodge.

"Calculation Methods for Countercurrent Leaching," Edwin M. Baker.

"Thermal Properties of Dowtherm A," D. S. Ullock. G. A. Gaffert, P. R. Knox and G. G. Brown.

"The Effect of Viscosity on Coefficients of Heat Transfer in Forced Circulation Evaporators," Jesse Coates and W. L. Badger.

"Degreening of Fresh Spirits (Ageing of Whiskey)," Charles A. Thomas.

"Industrial Medicine and Industrial Toxicology," Dr. G. H. Gehrmann.

"Latest Developments in Photography as Applied to Research," Dr. Walter Clark.

"Recent Metallurgical Advancements With Relation to Their Effect on the Chemical Industry," Clyde E. Williams.

"Buildings for the Chemical Industry," H. S. Jacoby.

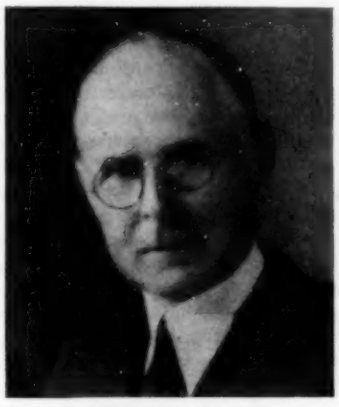
"Controlled Atmospheres in the Annealing and Heat-Treating of Steel," W. R. Gillett.

"An Investigation of the Use of Molten Tin and Lead in the Cracking of Petroleum," by a member of the staff of Battelle Institute.

Short business meetings will be held on Wednesday and Thursday mornings, Nov. 13 and 14 with the annual business meeting scheduled for Nov. 15. Results of the ballot on election of officers for 1936, will be announced at the first business session of the meeting.

Frank J. Tone Receives Acheson Award

BEFORE a large and friendly audience of electrochemists and engineers assembled in Washington, October 10, for the 68th meeting of the Electrochemical Society, Dr. Frank J. Tone of Niagara Falls received the Edward Goodrich Acheson Medal and $1,000 prize. The latter he returned to the Acheson fund for use in furthering worthwhile research in electrochemistry and in electro-thermics, the field in which Dr. Tone has made so many



Frank J. Tone

worthwhile achievements. Presentation of the Acheson medal was made by President James H. Critchett, following intimate and inspiring talks of the medalist by Dr. F. M. Becket and Dr. C. G. Schluederberg. Dr. Tone then briefly and modestly related the interesting story of the forty years he has spent, first as works manager and since 1919 as president of the Carborundum Co.

Dr. Tone originated the first commercial process for the production of silicon metal, discovered silicon monoxide and fibrous silicon oxycarbide and developed silicon carbide heating elements and other high-temperature products of silicon. He was awarded the Schoellkopf medal of the American Chemical Society in 1931. In 1900 Dr. Tone married Gertrude Franchot of Niagara Falls and they have two sons Frank Jerome and Franchot. The latter made a special trip from Hollywood to witness the presentation of the Acheson award to his distinguished father.

Court Upholds Lever in Soap-Making Process

ON Sept. 14 Judge Thomas W. Slick of the U. S. District Court at South Bend, Ind., rendered a decision which held that the spray drying process of producing soap employed by Lever Brothers at Hammond, Ind., did not constitute an infringement of the Lamont patent as contended by the Colgate-Palmolive-Peet Co. and the Procter & Gamble Co. The two latter companies had charged that the Lever company had infringed their process patents in the manufacture of "Rinso" and an accounting of profits from 1927 was demanded. In his decision Judge Slick stated that the defendant should be commended for improving its product and that inasmuch as it made several improvements from 1910, when it started manufacturing spray-dried soap, up until 1927, when the Lamont patent was issued, it should not be required to stop improving its product because of the issuance of the patent.

New Anti-Freeze Product Offered by duPont

ANNOUNCEMENT is made by E. I. duPont de Nemours & Co. that its Organic Chemicals Department has developed a new anti-freeze for automobile radiator protection called "Five Star Anti-Freeze," which contains the qualities of protecting, against corrosion, all metallic parts of the cooling system. This anti-freeze has been developed following exhaustive laboratory and severe practical tests. It contains five major ingredients that are considered necessary to provide complete protection. The name is derived from the five ingredients.

Export Association Formed For Wood Naval Stores

THE Wood Naval Stores Export Association has filed papers under the Export Trade Act (Webb-Pomerene law) with the Federal Trade Commission, for exporting FF wood rosin and pine oil. The association will maintain offices at Wilmington, Del.

Officers of the association are: N. P. Hatten, chairman; A. B. Nixon, secretary; L. H. Dreyfus, and H. A. Mackie, directors. Members are: Phoenix Naval Stores Co., Inc., Gulfport, Miss.; Dixie Pine Products Co., Hattiesburg, Miss.; Hercules Powder Co., Wilmington, Del., and Mackie Pine Products Co., Covington, La.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

WASHINGTON is trying, somewhat vainly, to weigh the good and the bad influences affecting business in a large way. Business is unquestionably more active. The immediate pressure for new legislation, new regulatory measures, new taxes is being relieved. The President's recent public speeches make clear his feeling that there is real need for the promised breathing spell, and desire to grant it so far as politics permits. Hence on that score, jitters are less common, less justified than formerly.

Unpleasant entries in the ledger of trends include increasing evidence that labor will press with its full force for a 30-hour week bill next Winter; continuing evidence that bonus legislation is likely to be enacted even over Presidential veto in January; and no evidence that real progress is made in relieving unemployment despite huge government spending. The President's promise of no new taxes next year, both politically expedient and a pleasant promise to business, can hardly be expected to prevail in fact.

War-like developments and attempt at munitions control by the United States introduce no greater complexity than these business and budget problems. Those who might otherwise sell wanted material to Italy, and to Ethiopia if they could get it delivered, must not count on that possibility. Washington believes, probably rightly, that it has an almost unanimous mandate from the American people to avoid even the appearance of infringement of neutral attitude. No war supplies are likely to go directly to these initial belligerents.

Whether embargoes will extend to League of Nations' agencies, should Britain or others undertake forceful interference, is another question. Washington guesses, it cannot be more certain than that, that League agencies would receive any aid which the American Government or American industry could offer without interference. A decision of the President in such matters is unquestioned. The National Munitions Control Board is not required to limit exports, other than to the initial participants in the warfare, nor with respect to commodities of importance that are not per se "arms, ammunition, or implements of war." Strangely enough, even explosives not made up into ammunition are not included in the first lists from this Board.

Efforts to broaden the neutrality act, so that its prohibitions can be leveled against copper, cotton, chemicals and all products regarded as war supplies instead of just the arms, ammunition and implements of war to which it is now limited, will be launched at the reconvening of Congress in January. A bitter fight against the possibility of a ban on copper and cotton, with heavy political pressure from Southern and Western States, is freely predicted.

At present the "arms, ammunition and implements of war" limitation prevents legal extension of the prohibited list much farther than has already been announced. This despite the indications from administration officials that the list would be added to freely from time to time.

In enforcing the prohibitions it will be able to promulgate under the present neutrality law, the government does not intend to operate in a manner that will hamper trade, but it will carefully watch to see that the banned products are not passed on to a belligerent nation via a non-belligerent, such as it has found to be the case in Latin America in the past.

It is expected, however, that there will be an upturn in the munitions business on the theory that every nation that possibly might become involved will want to prepare itself. This is held to be particularly true with regard to the known war supplies other than arms, ammunition and implements of war.

Code making now may proceed under Federal Trade Commission procedure alone only if no labor requirements are included. A review by NRA is expected with respect to all labor matters. That agency again reorganized under Major George L. Berry, is given full authority to review such questions and FTC will presumably accept NRA findings as final in these respects. But final formal code promulgation, according to the new plan, again requires Presidential blessing.

Objectives of Major George L. Berry are two-fold: first, to expedite the approval of voluntary Fair Trade Practice Agreements incorporating, as a new feature, provisions limiting wages and hours, and to act as arbiter of the justice of such limitations as an agent of the President; second, to develop, through hearings at which representatives of management, labor and the consumer will express their views, a permanent machinery for eliminating cutthroat competition injurious not only to capital, but also to all dependent upon it.

Trade Practice Agreements, as before, will clear through the Federal Trade Commission and, when limited to traditional form, will not be subject to Major Berry's supervision. Industry will be encouraged, however, to expand them by including new provisions declaring the underpayment or overworking of labor, or the use of child labor, to be unfair practices, in the belief that this will give industry a means of eliminating the chiseller by voluntary action. In such cases the proposed codes will be separated into sections subject to FTC approval, as before, and the new labor sections to be passed upon by Major Berry. Dual approval will be necessary before the codes become effective, and they will also be subject to review by the President. Legal authorization for such action is contained in the Congressional resolution extending NRA in skeleton form; it will expire April 1, 1936, unless extended by Congress.

The second objective is still nebulous in form. Major Berry plans to receive the ideas of management, labor and the consumer in series of conferences to be held shortly, and expects, with this experience as a guide, to evolve some form of permanent machinery which will make possible the elimination of the wage-cutter and hour-chiseller from the industrial scene through the cooperation of all factors in business. He points out that, because of the inescapable community of interest existing among management, labor and the consumer the problem of eliminating cutthroat competition should receive the attention of all three.

The last important legislative action of Huey Long in Washington was to filibuster against the final deficiency appropriation bill. By its defeat a number of the new alphabetic agencies, and some of the old ones, failed to receive wanted monies. Oddly enough, the effect of this is proving constructive. The new bodies are being more slowly and carefully organized. Plans for action are being considered in a deliberate sane manner. Notably, benefits are expected from the planning and more conservative initiation of work by the National Labor Relations Board. When the money is granted in January, as it unquestionably will be, procedure along orderly lines can be expected. Thus there comes conservative and stabilizing influence from what at the time seemed to be most radical action. And in that respect, all industry will be benefited.

Organization of the World Power Conference of September, 1936, for which invitations have been issued to other nations is taking form in Wash-

ington. Under the general chairmanship of Secretary Ickes, a committee about half official, half power company in leanings, will plan a series of sessions. O. C. Merrill, former executive secretary of the Federal Power Commission and long experienced in power organization programs, is to be the executive officer. The broad theme of the conference as tentatively suggested is: "The national power economy; physical and statistical bases; technical, economic and social trends; organization of fuel industries and of gas and electric utilities; public regulation; national and regional planning; conservation of fuel and water resources; rationalization of distribution; national power and fuel policies." From this it is evident that the series of sessions may prove to be essentially a field day for public ownership and "yardstick" advocates.

Alcohol control is now administered 100 per cent by the Treasury Department subsidiary, Federal Alcohol Administration, with Franklin C. White, a New York Republican, as administrator. Continuing from the Choate régime are Harris E. Willingham, as associate administrator, and John F. Moore, as acting general counsel. Most significant to chemical industry is that the new setup provides closer affiliation between tax collection and industrial alcohol matters. Thus desire for enforcement is joined with the problem of allowing industry reasonable freedom of legitimate use. Definite evidence indicates that for this, and other important personal reasons, there is little expectation of approval of the methanol-denaturant formula long urged by both wood-distillation and industrial-alcohol groups.

An organic chemical substitute for lead arsenate is being recommended by the Bureau of Entomology. This is phenothiazine, a sulphur-containing derivative of diphenylamine. This has been tested out in two areas for two seasons and seems more effective as a stomach insecticide for coddling-moth control than the metalliferous insecticide which it replaces. It is particularly important to have such substitution in the case of fruit and vegetable treatment in order to eliminate the possibility of metallic-spray residues of toxic nature.

Government specialists make no forecasts as to the magnitude of the substitution to be expected soon, but they think that this type of change in insecticide practice is likely ultimately completely to eliminate lead and arsenic from those insecticides used on vegetation subsequently marketed for food use. In the case of green vegetables the rotenone type of contact insecticide is, of course, recommended.

Tariff on camphor continues indefinitely five cents per pound, following the formal announcement in late September of the official approval by the President of the Tariff Commission report. For the third successive year the domestic production of synthetic camphor exceeded the required per cent of the domestic consumption during the six-months' test period. Official determination of this fact prevents the reversion of the tariff to the one-cent level, which change would have followed if the required quota (50% this year) had not been met.

Advertising yeast and products made from it as pimple removers and beauty aids is all right, but from now on it is going to cost money. The Bureau of Internal Revenue brought suit against the Red Star Yeast Co. in the Milwaukee Federal Court, contending that the company's product so advertised was subject to the 10 per cent levy on cosmetics in the nuisance tax law. The court upheld the government's contentions. More cases are to follow.

Statistical agencies in Washington are being flooded with requests for commodity price data for the period following the outbreak of the World War. The record shows that after the initial flurry, which depressed nearly all prices, commodities rose rapidly until our entry into war. So many price controls then were put into effect that the curve flattened, but when restrictions were removed after the armistice the advance continued until the price break of 1920.

Although nothing so spectacular is expected to follow this outbreak of war in the Old World economists think the general price tendency will be the same. The trend of commodity and stock prices will be upward, it is expected. Fixed interest obligations are not expected to suffer immediately as war in Europe would tend to increase the prestige and the relative importance of the United States.

It is realized that the task of controlling inflation has been made infinitely greater. Pressure against control will be so great that it will be difficult to apply restrictive measures soon enough. Under present law the brunt of control must be taken by the board of governors of the Federal Reserve System.

Sales of Lime Increased Last Year

THE lime sold by producers in the United States in 1934 amounted to 2,397,087 short tons valued at $17,164,024, according to figures compiled by the U. S. Bureau of Mines. This represents an increase of 6 per cent in quantity and 20 per cent in value compared with 1933. Sales of hydrated lime, which are included in the above totals, amounted to 829,430 tons valued at $6,324,623, a decrease of 1 per cent in quantity and an increase of 12.5 per cent in value. The average unit value of all lime in 1934 was $7.16 a ton compared with $6.28 a ton in 1933 and 1932; hydrated lime showed an increase from $6.69 a ton in 1933 to $7.63 a ton in 1934.

Sales of lime used in the manufacture of chemicals—1,663,591 tons valued at $11,425,031—increased 12 per cent in quantity and 25 per cent in value; lime sold for construction—511,419 tons valued at $4,260,865—decreased 4 per cent in quantity and increased 11 per cent in value; and that sold for agricultural purposes—222,077 tons valued at $1,478,128—decreased 10 per cent in quantity and increased 11 per cent in value.

Polymerization Unit for Pan American Refining

PLANS have been completed and contract awarded for the construction of a catalytic polymerization unit for the Pan American Refining Corp. at its refinery at Texas City, Tex. The Universal Oil Products Co. developed the polymerization process which will be used in the new unit. The unit will have a daily capacity of 27 million cubic feet of gas and is expected to turn out about 2,000 bbl. of polymerized gasoline daily. Plans call for the new unit to be in operation next year and it will make use of cracked gases from the refinery at Texas City which may be expanded in order to double its present output. The polymerized gasoline will be blended with the regular gasoline run of the refinery so as to improve its anti-knock properties. The anti-knock gasoline will be supplied exclusively to the American Oil Co., marketing subsidiary of Pan American Petroleum & Transport Co.

Production of Chromite Started in Ontario

FOLLOWING preliminary experimental work at Niagara Falls, N. Y., The Chromium Mining & Smelting Corp., Ltd., of Sault Ste Marie, Ontario, Canada, has started production of chromite at Sault Ste Marie. Canadian deposits of chrome ore are found in Ontario, Quebec, and British Columbia. These deposits do not run sufficiently high in chromic acid content to make them desirable for chemical manufacture and the new production is reported to be intended for production of alloy steels.

GERMAN GOVERNMENT AIDS RESEARCH INTO FUELS FOR TRANSPORTATION

INSTABILITY of world commerce has had its effect on exports of the German chemical industry, which has suffered considerably. Losses were felt most keenly in chemical industries because about 50 per cent or more of their productions were destined to foreign countries. However, it became evident, even in 1934, that the loss of chemical exports to certain countries could be equalized by sales concentration in other regions.

Total exports of heavy chemicals amounted to 1094-million tons in the first six months of 1933; it jumped to 1295-million tons in the same period of 1934; and the first six months of the present year showed a total of 1480-million tons. The totals of all chemical exports; that is, heavy chemicals plus paints, varnishes, ethers, alcohols, fertilizers, explosives, etc., increased during these same periods from 1233-million tons in 1933 to 1436-million tons in 1934, to 1636-million tons in the current year. The increase during the present year was about 13.9 per cent.

Certain chemicals, such as aniline dyes, and also such others as ultramarine, white lead and zinc oxide, showed a very healthy increase in export sales. Cosmetics alone enjoyed a 50 per cent increase over the previous year.

The Reich's Transportation Ministry, supported by German industry, has organized the Association for the Promotion and Use of Domestic Fuels. Its object is to further research into, and the use of, domestic fuels for transportation purposes. In a recent address before the association, Prof. Dr. Ubbelohde called attention to the great significance of the brown coal industry in its relation to supplying German motor fuel; and he remarked that with national cooperation, Germany would soon be in a position to produce all of its own fuel from domestic raw materials.

The use of illuminating gas as a motor fuel has been in the experimental stage for the past 18 months, during which time a 1½-ton truck has been running under observation and with this fuel exclusively. The performance to date has been entirely satisfactory. The Berlin Transport Co. has recently turned over for experimental purposes several of its large passenger buses. The steel gas cylinders in these large buses can carry only sufficient fuel for an 80-kilometer run, and since they make daily runs in excess of 200-kilometers, a special gas-tank station has been placed in service. This station fills steel flasks with 112 cubic meters of the gas at 200 atm. The use of liquid gases such as butane and propane, which would enable a truck to carry sufficient fuel for an average day run, is prohibited because of the price. A specially equipped experimental truck, using domestic fuels of all sorts, is now making an 8000-kilometer tour of Germany.

The first plant for mass production of synthetic caoutchuc rubber is almost completed, in Piesteritz, near Wittenberg. It will be in full operation in November or early December of this year.

Methods of producing pitch-coke for electrodes and particularly for electrochemical purposes have been greatly improved during the last few years. The iron previously used in the retorts of the pitch coke processes was rendered useless in but a short time; and the use of brick in the construction of muffle ovens gave birth to numerous structural difficulties. Clay retorts, too, proved useless because of uneconomical heating methods in use with them.

As long ago as 1928 efforts had been made to provide a pitch-coke containing only 1 per cent of volatile constituents, but when this goal was achieved, the standards set up by the aluminum industry (principal users of electrode raw material) dictated that aluminum may contain not more than one-tenth of one per cent of foreign substances. All of which meant that an improved technique in the manufacture of this substance was essential. Subsequent improvements in production methods have allowed the rebuilding of plants so that they are now capable of producing about 36,000 tons annually.

The product is a technically pure carbon with an ash-content of from 0.4 per cent to 0.5 per cent and with volatile constituents varying from 0.5 per cent to 0.7 per cent. This coke, which has withstood temperatures of 1000 deg. C. for eight hours, is, therefore, practically free of all volatile substances.

In evaluating pitch-coke as basic material for production of electrodes, consideration must be given to its structural characteristics: to qualities of density and brittleness; and also to conductivity factors. These electrodes are highly conductive to electric currents and they show also great resistance to chemical and thermal activity. In view of the fact that we are merely on the threshold of the age of lighter metals, it is significant that the anode mass needed in the production of one ton of aluminum has been reduced from 950 kg. to 520 kg. in the very few years since the war.

Pitch coke has been found useful also in the production of synthetic graphite, carbon brushes, grinding disks and filter stones.

Fischer and his associates announce a new process for the production of raw material for the Fischer benzine synthesis. It refers to the utilization of coking gas that has been passed over coke with steam. The mixture contains carbon monoxide and hydrogen in the proportion of 1:2. By varying the proportions of coke and steam and the blast and time factors, the carbon monoxide and hydrogen content may be altered considerably. The gas may be generated in a continuous and a very simple manner from the coking gas and coke. The unburnt end-products of the benzine synthesis, containing carbonic acid, carbon monoxide, hydrogen and hydrocarbons, can be utilized in further synthetic operations by the same process.

Tars and oils of various types, natural gas and petroleum gas, lend themselves also to this type of synthesis.

A small apparatus which softens water and removes dissolved salts by an electro-osmotic process has found a field of usefulness in those areas where pure water is an absolute necessity. It has already established itself in the aviation industry, where it provides pure water for engine radiators and for storage batteries. The apparatus, made by Siemens & Halske, has a daily capacity of 20 liters and is very simple in construction and in operations. It operates with alternating current a 60-110 volts, and at the latter voltage consumes 5 amperes. It consists of a box divided along its long axis into three cells by two diaphragms. Water to be purified is placed in the middle cell, while the electrodes are situated in the two adjacent divisions. Under the influence of the electric current, the dissolved salts of the water flow into the side cells and the purified water passes through a small overflow funnel into the retaining flask.

CALENDAR

AMERICAN PETROLEUM INSTITUTE, annual meeting, Los Angeles, Nov. 11-14.

INTERNATIONAL ACETYLENE ASSOCIATION, annual meeting, Cleveland, Nov. 12-15.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Columbus, Ohio, Nov. 13-15.

EXPOSITION OF CHEMICAL INDUSTRIES, New York, week of Dec. 2-7.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York, Feb. 17-20.

ELECTROCHEMICAL SOCIETY, annual meeting, Cincinnati, Apr. 23-25.

NAMES *in the News*

William R. Veazey

Ernst A. Hauser

WILLIAM R. VEAZEY, head of the department of chemical engineering at Case School of Applied Science, and a member of its faculty since 1907, will leave the Institute in June of next year. In addition to his professorship, Dr. Veazey has served as head of the graduate division and as chairman of the committee on business option. In the future he will devote his entire time to the executive staff of the Dow Chemical Co. His connection with the company goes back to 1915, in 1927 he succeeded Dr. A. W. Smith as a director and as consultant on research and patent activities.

SPENCER L. CARTER has resigned as first vice-president in charge of operations of the Virginia-Carolina Chemical Corp. He remains as a director and as president of the Tobacco By-Products and Chemical Corp.

B. D. SAKLATWALLA, vice-president and director of the Vanadium Corp. of America, has tendered his resignation to devote his main efforts to the formation of a new organization for research and development, especially in connection with steels and alloys, and for rendering service of an advisory nature with the aid of expert associates in metallurgical and chemical fields.

E. C. MCMILLEN, formerly instructor in chemical engineering at the University of Minnesota has been appointed assistant professor of this subject at Iowa State College.

ERNST A. HAUSER, internationally known for his research on rubber and other colloidal materials, has been appointed associate professor of chemical engineering at the Massachusetts Institute of Technology. He assumed his new duties at the opening of the academic year.

DR. HAUSER received his doctor's degree from the University of Vienna in 1921. He served as assistant to Prof. Max Born at Gottingen, Germany, for a year, and became first research chemist for the Krause Dried Products Co. at Frankfort-am-Main in 1922. He was appointed chief chemist of the Colloid-Chemical Laboratory of Metallgesellschaft A.-G. when it was founded in 1925. Since 1933 he has been chief chemist of the "Semperit" Austro-American Rubber Works, in Vienna.

DANIEL GRAY is chief chemist of the recently organized Pre-Metals, Inc. of Utica, N. Y.

HENRY M. CADOT, a chemical engineering graduate from the University of Virginia in June 1935, has joined the staff of E. I. du Pont de Nemours and Co., at their Charleston, W. Va., ammonia works.

EDWARD A. BELMORE, national prize winner in the American Institute of Chemical Engineers' problem contest, has accepted a position in the research and development department of Westvaco Chlorine Products Co. at South Charleston, W. Va. He received the B.S. degree in chemical engineering at the University of Virginia last June.

JOHN S. ZINSSER, formerly in charge of research and development for Merck & Co., has accepted the presidency of Sharp & Dohme.

ARTHUR E. WELLS has been appointed manager of the Beetleware department of American Cyanamid Co. R. S. Childs recently resigned the management to devote his efforts to the Lederle Laboratories division of Cyanamid.

H. SEYMOUR COLTON has resigned his position as head of development of industrial chemicals for Grasselli Chemical Co. He has established a consulting practice in Cleveland. Since his graduation from M.I.T. in 1921, he has been closely connected with the heavy chemical industry.

JOSEPH H. SAVILLE has been elected president of the Pyrites Co. He succeeds William Seguine, Jr.

GERALD F. LOUGHLIN has been appointed chief geologist of the U. S. Geological Survey. Dr. Loughlin succeeds Dr. Timothy W. Stanton who is retiring. The latter entered the service of the Geological Survey in 1889.

OBITUARY

H. NORMAN SPICER, 70 years old, died at his residence in New York on October 8. He was a native of England and at the time of his death was a director of the Dorr Co., New York.

OREL SAMUEL GRONER, formerly professor of chemistry at Bucknell University, died September 6, at his home in Lewisburg, Pa. Death was due to a heart attack caused by a long siege of whooping cough. He was 64 years of age. Professor Groner graduated from both Michigan State College and the University of Michigan. He had served on the chemistry faculty of Transylvania College, Ottawa University, and Grand Island College.

WILLIAM HUTTON BLAUVELT died September 13 at Pasadena, Calif., at the age of 72 years. He was born in Elizabeth, N. J., and attended Lafayette, Lehigh and Princeton universities. For many years he was interested in the development of the byproduct coke oven and manufacture of coke and its by-products. He was with the Semet-Solvay organization at Syracuse, N. Y., for 27 years as general manager and consulting engineer. In recent years he was associated as chief engineer with the Columbia Gas & Electric Co., but resigned in 1932 because of ill health.

Chemical ECONOMICS

THE improvement in business activity, which has been noted during the last few months, continued during August and the first half of September, according to the regular monthly survey of the National Industrial Conference Board.

Referring to activities in August, the Federal Reserve Board pointed out that its index, which is adjusted to allow for usual seasonal variations, remained unchanged at 86 per cent of the 1923-25 average. Without seasonal adjustment the index, based on preliminary figures, was 3 points higher than in July.

Activity at steel mills showed a considerable increase from July to August, the board reported, and in the first three weeks of September was at a level higher than in any other month since February.

Factory employment and pay rolls increased between the middle of July and the middle of August by more than the usual seasonal amount. Marked increases in employment were reported for the steel, machinery, lumber, silk and clothing industries, while at automobile factories employment declined somewhat. The number of wage earners engaged in the production of durable manufactures in August was 6 per cent larger than a year earlier, while the volume of employment in other manufacturing industries as a group showed little change. Total factory employment was 3 per cent larger than in 1934.

The outlook for the final quarter of this year is favorable if the movement of raw materials and finished products may be taken as a criterion. According to estimates of the thirteen Shippers' Regional Advisory Boards, car loadings for the fourth quarter will be 6.4 per cent above the actual loadings in the last quarter of 1934.

Of the twenty-nine commodities included in the estimate, increases are expected in twenty-five while decreases are expected in four. The twenty-five for which an increase is estimated follow: Grain; flour, meal and other mill products; cotton; cottonseed and products except oil; citrus fruits; other fresh fruits; potatoes; other fresh vegetables; coal and coke; ore and concentrates; gravel, sand and stone; salt; lumber and forest products; petroleum and petroleum products; sugar, syrup and molasses; iron and steel; machinery and boilers; brick and clay products; lime and plaster; agricultural implements and vehicles other than automobiles; automobiles, trucks and parts; fertilizers; paper, paper board and prepared roofing; chemicals and explosives and canned goods.

In the case of chemicals and explosives the per cent of gain is estimated at 6.4; for fertilizers, 5; iron and steel, 22.3; and petroleum products, 2.3.

The textile industry has continued to present a good market for chemicals. Wool consumption for some time has held at a rate surpassing that of the last 17 years. Consumption of wool in August was reported at 74,781,000 lb. but this figure was high because it covered a five-week period rather than the calendar month. Estimates for September indicate a steady rate of operations.

Rayon deliveries in September not only made a new record for the industry but were larger than the output for that month so that stocks were drawn upon to make the required deliveries. As a result producer stocks are depleted and deliveries over the remainder of the year will be limited by production.

Takings of cotton by domestic mills in September are estimated at more than 420,000 bales which if verified will show a decided increase over the 296,000 bales taken in September of last year. In September, 1934, many plants were closed because of strikes. Deliveries of silk in September ran ahead of the earlier estimates and amounted to 45,156 bales which was an improvement on the August total and exceeded deliveries in September, 1934, by 12,557 bales.

Judging from statistics for ethyl alcohol and methanol, production of solvents in the last few months—in fact all through this year—has been on an expanding scale. The output of synthetic methanol in August was larger than in any preceding month of this year. It is worthy of note that production of synthetic methanol has exceeded 1,000,000 gal. every month of this year and record production is a certainty for the year. The output of crude methanol also has been speeded up this year and shows a better than 10 per cent increase for the first eight months of this year over the like period of 1934.

While consumption of sulphuric acid in the fertilizer trade has held below that of last year, the figure for August lessened the difference to about 25,000 tons. The National Fertilizer Association reports sales of fertilizer tags in the southern states for the first eight months at 3,504,039 tons or a gain of 12 per cent over the 1934 eight-month total. The association also reports that the seasonal upturn in production of superphosphate which began in July continued in August, with the July to August rise amounting to 16 per cent. Output was nearly 50 per cent larger than in August of last year but was well under the figure for the same month of 1933. Production in the first eight months of the current year has been larger than in any corresponding period since 1930, exceeding the Jan.-Aug. period of last year by 5 per cent.

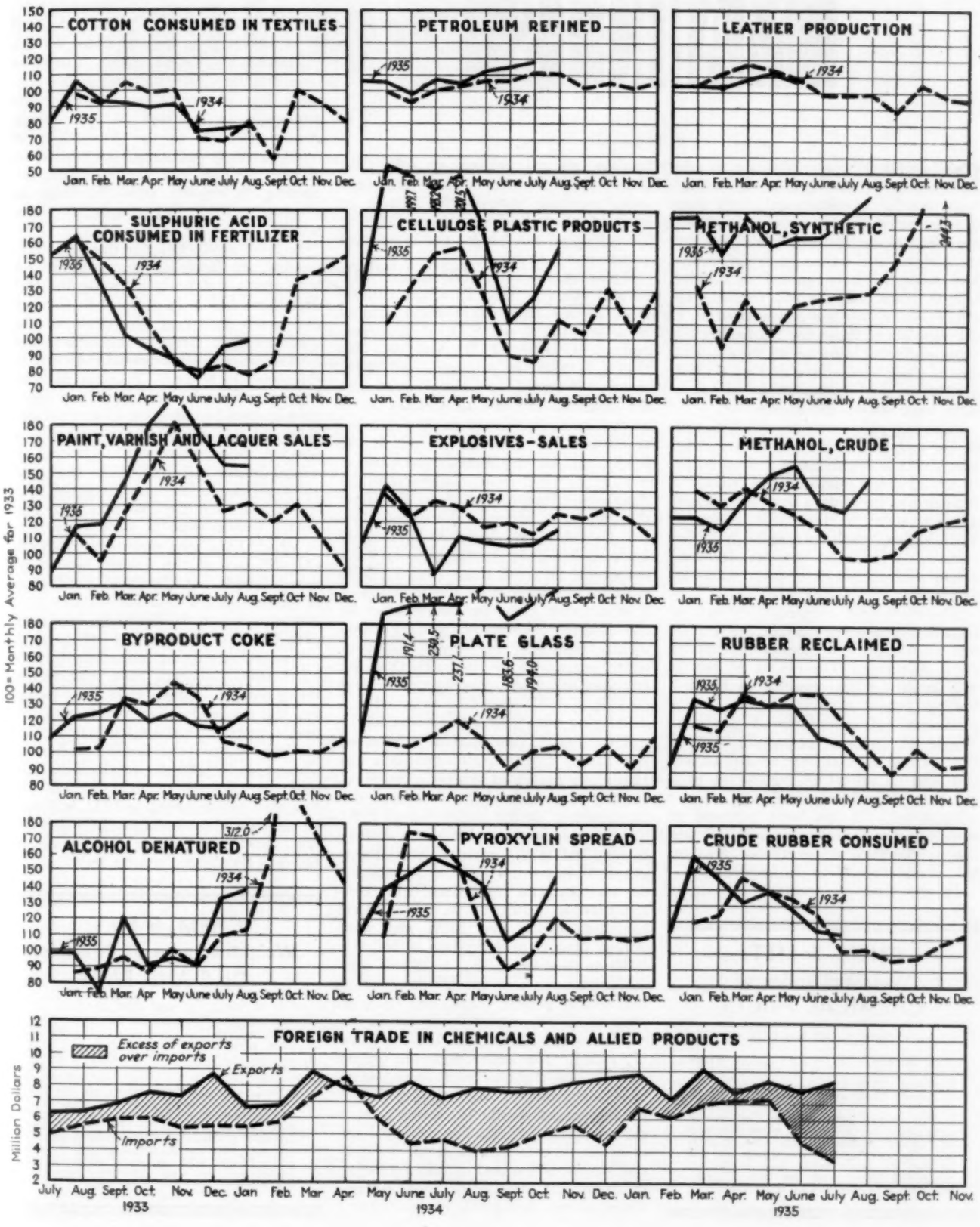
Consumption of crude rubber by American manufacturers increased sharply during August, according to a report compiled by the Rubber Manufacturers Association. The total amount used is placed at 39,242 long tons, compared with 36,384 long tons in July.

Production and Consumption Data for Chemical-Consuming Industries

	Aug. 1935	Aug. 1934	Jan.-Aug. 1935	Jan.-Aug. 1934	Gain Jan.-Aug. 1935 over Jan.-Aug. 1934 Per Cent
Production					
Alcohol, denatured, 1,000 wi. gal.	8,580	6,943	51,878	47,255	9.8
Arsenic, crude, tons	1,848	628	11,249	9,516	18.2
Arsenic, refined, tons	633	388	6,422	4,157	54.5
Automobiles, No.	240,051	234,811	2,839,240	2,214,007	28.2
Byproduct coke, 1,000 tons	2,778	2,278	21,901	21,032	4.3
Glass containers, 1,000 gr.	3,825	3,169	25,733	23,886	7.7
Plate glass, 1,000 sq. ft.	14,526	7,450	116,798	62,581	86.6
Methanol, crude, gal.	382,331	253,612	2,811,597	2,539,140	10.7
Methanol, synthetic, gal.	1,389,812	951,834	9,970,128	7,053,617	41.3
Nitro-cellulose plastics, 1,000 lb.	1,285	956	10,226	8,351	22.5
Cellulose-acetate plastics, 1,000 lb.	595	375	6,600	3,215	105.3
Pyroxylin spread, 1,000 lb.	4,471	3,654	33,699	30,700	9.8
Steel barrels, No.	529,414	316,340	4,124,929	4,745,383	13.1*
Steel sheets, tons	206,613	77,197	1,578,011	1,411,714	11.8
Rubber reclaimed, tons	7,263	8,160	75,898	77,888	2.6*
Sulphuric acid in fertilizer trade, tons	123,209	97,478	1,048,081	921,583	13.7
Consumption					
Cotton, 1,000 bales	408	421	3,624	3,706	2.2*
Silk, bales	41,715	36,247	331,249	301,512	9.8
Explosives, 1,000 lb.	23,957	26,063	175,474	193,345	9.2*
Paint, varnish, and lacquer, sales, $1,000	28,699	23,771	228,665	195,032	17.2
Sulphuric acid in fertilizer trade, tons	99,673	77,404	852,178	877,227	2.9*

*Per cent of decline.

TRENDS OF PRODUCTION AND CONSUMPTION



The MARKETS

DELIVERIES of chemicals to consuming trades gained in volume last month. Metallurgical lines have drawn more freely on raw material supplies, textile demands have been well maintained, anti-freeze grades of alcohol and methanol have gained in volume, carbon black has moved freely—September deliveries being estimated at 15 per cent above those for September last year—different branches of the glass industry have been active and as a whole production and consumption of chemicals have shown expansion.

A strong price tone has ruled in spite of the fact that sharp cuts in prices for zinc oxide brought about a drop in the weighted index number. The outlook is regarded as favoring a firm price schedule for some of the basic chemicals with higher levels probable in a few instances. Oils and fats are decidedly firmer with increases in price noted for practically all selections.

The three-cent compensatory tax on imported products, manufactured from oils now subject to assessment, has become operative. The tax of 3c. per lb. will apply on the quantity of the following crude materials used in the production of manufactured products: Whale oil (except sperm oil), fish oil (except cod oil, cod-liver oil and halibut oil), marine animal oil, sesame oil, palm oil, palm kernel oil, sunflower oil and coconut oil. It has been assessed on such oils for three years and the new law is designed to overcome evasions by manufacture prior to importation.

In the case of products containing coconut oil not originating wholly in the Philippine Islands and not made from materials entirely the growth or production of the islands there will be an additional tax of 2c. per lb. on the quantity of coconut oil.

Treasury Decision 4578 issued Aug. 13 and effective Oct. 1, which authorized the use of tertiary butyl alcohol as a denaturant for S.D. alcohol, formulas 39, 39-A 39-B, and 40, has drawn a storm of protests from denaturers. Protests were based mainly on the fact that the use of tertiary butyl alcohol as a denaturant in ethyl alcohol is covered by a patent on which the holder demands royalties for such use.

Protests also were made against a Treasury ruling of Oct. 5 to the effect that stocks of specially denatured alcohol formulas 39, 39-A, 39-B, and 40 compounded prior to October 1, 1935, remaining on hand after Dec. 1, 1935, must be redenatured on the premises of a denaturing plant by the addition of the proper amount of tertiary butyl alcohol specified for these formulas, prior to removal for use. To this end, any such stocks held by bonded dealers on Dec. 1, 1935, should be returned to a denaturing plant for redenaturation.

The Tariff Commission announced last month that the President has approved its report on synthetic camphor. In this report, the last of three under paragraph 51 of the Tariff Act of 1930, the Commission found that no change is required in the rate of duty. Paragraph 51 imposes a duty of 5 cents per lb. on synthetic camphor. The consumption of 1,169,414 lb. of synthetic camphor during the third and final period of the investigation (Dec. 18, 1934, to June 17, 1935), compares with the consumption of 886,428 lbs. during the second period (Dec. 18, 1933, to June 17, 1934), and 397,138 lb. during the first period (Dec. 18, 1932, to June 17, 1933). The entire domestic output was by one manufacturer until late in 1934 when another domestic firm began production of synthetic camphor at a plant in New Jersey. The principal use of synthetic camphor is in the production of pyroxylin and celluloid articles, including the thin sheets used in laminated or non-shatterable glass. Natural crude camphor, a product of Japan, is largely interchangeable with synthetic camphor in this use.

Iodine exports from Chile amounted to 502,000 kilograms during 1934-35, against production of 587,000 kilograms during the same period. Production continues in private hands but all sales and exports of iodine are regulated by the Nitrate and Iodine Sales Corp., a monopoly in which the Chilean Government has a controlling interest. The monopoly is reported to be making studies relative to the production of other products including pure potassium nitrate, sodium iodide and iodate, according to reports from Santiago as received at the Department of Commerce.

Arsenic production for the first eight months of this year shows gains for both crude and refined despite the fact that there has been a trend in the last two years to larger shipments of the crude product direct to consumers and consequently a corresponding decline in shipments to refiners. Increase in mining operations has resulted in a large gain in world production of arsenic this year and this stands in the way of any upward price movement. Imports of white arsenic for Jan.-Aug. this year amounted to 10,518 tons compared with 10,072 tons for the like period of last year. August imports were 1,318 tons of which 1,117 tons came from Mexico. Only 95 tons of the August total came from Canada yet Canadian production of arsenic in the first half of this year was reported at 1,729,000 lb. compared with 621,000 lb. in the first half of 1934.

The two remaining independent Spanish potash producers have now signed the European Potash Pact thus bringing the entire Spanish potash industry under international cartel control, according to reports to the Department of Commerce. Spanish production, like that of Poland, which joined the Franco-German group in 1932, will now be distributed to world markets through the export organization of the Franco-German Syndicate, reports state.

CHEM. & MET.
Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**87.01**
Last month	87.35
October, 1934	87.71
October, 1933	86.05

Tin salts, lead oxides, antimony oxide and naval stores were marked up in price during the last month but the drastic cut in prices for all grades of zinc oxide had a larger weighted effect and the index number for the month was lowered.

CHEM. & MET.
Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	**94.08**
Last month	87.98
October, 1934	74.02
October, 1933	53.07

Animal fats were bringing higher prices and most of the vegetable oils did likewise. There was a sharp recovery in values for cottonseed oil. Linseed oil was marked up and near-record prices prevail for China wood oil. Palm and sulphur oils were prominent on the up side of the market.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 14.

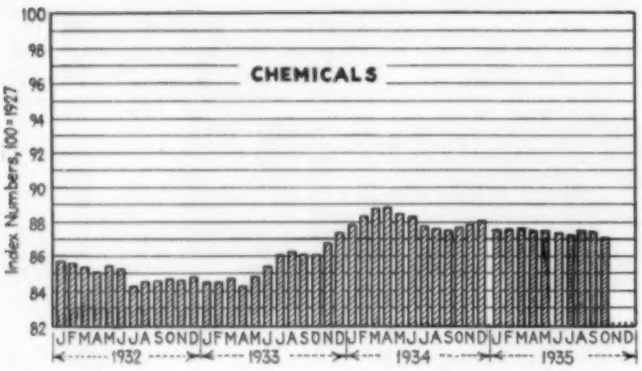
Industrial Chemicals

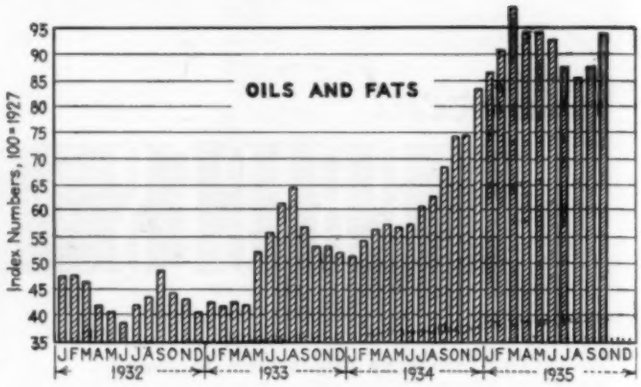
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.12 –$0.12½	$0.12 –$0.12½	$0.12 –$0.12½
Acid, acetic, 28%, bbl., cwt.	2.45 – 2.70	2.45 – 2.70	2.53 – 2.67
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.69 – 8.94
U. S. P. reagent	10.52 –10.77	10.52 –10.77	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	95.00 –105.00
Citric, kegs, lb.	.28 – .31	.28 – .31	.28 – .31
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Latic, 44%, tech., light, bbl., lb.	.12 – .12½	.12 – .12½	.12 – .12½
22%, tech., light, bbl., lb.	.06½– .07	.06½– .07	.06½– .07
Muriatic, 18°, tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½– .12½	.11½– .12½	.11½– .12½
Phosphoric, tech., c'boys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –.....	15.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb.	.24 – .25	.24 – .25	.25 – .26
Tungstic, bbl., lb.	1.50 – 1.60	1.50 – 1.60	1.40 – 1.50
Alcohol, Amyl	–.....	–.....	–.....
From Pentane, tanks, lb.	.15 –.....	.15 –.....	.143–.....
Alcohol, Butyl, tanks, lb.	.13 –.....	.13 –.....	.105–.....
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.27½–.....	4.27½–.....	4.15½–.....
Denatured, 190 proof			
No. 1 special, dr., gal.	.36 –.....	.36 –.....	.346–.....
No. 5, 188 proof, dr., gal.	.35½–.....	.35½–.....	.34 –.....
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd. tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.20 –.....	1.20 –.....	1.20 –.....
Amylacetate tech., tanks, lb.	.142–.....	.142–.....	.142–.....
Antimony Oxide, bbl., lb.	.12½– .12¾	.11½– .12¾	.07½– .08
Arsenic, white, powd., bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15 – .15½
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	74.00 –75.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.90 – 2.00	1.90 – 2.00	1.85 – 2.00
Borax, grain, bags, ton	44.00 –49.00	44.00 –49.00	40.00 –45.00
Bromide, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.10 –.....	2.10 –.....	2.25 –.....
Arsenate, dr., lb.	.06 – .07	.06 – .07	.05 – .06
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	17.50 –.....
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	19.50 –.....
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.00 –.....	2.00 –.....	.0185–.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.39 – 1.45	1.39 – 1.45	1.25 – 1.30
Copperas, bgs., f.o.b., wks., ton	14.00 –15.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb.	.08½– .16	.08½– .16	.08½– .16
Cyanide, tech., bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.85 – 4.00
Cream of tartar, bbl., lb.	.16½– .17	.16½– .17	.18½– .19
Diethylene glycol, dr., lb.	.16½– .20½	.16½– .20½	.14 – .16
Epsom salt, dom., tech., bbl., cwt.	2.10 – 2.15	2.10 – 2.15	2.10 – 2.15
Imp., tech., bags, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Ethyl acetate, drums, lb.	.08½–.....	.08½–.....	.08½–.....
Formaldehyde, 40%, bbl., lb.	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contact, lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal.	.75 –.....	.75 –.....	.75 –.....
Refined, dr., gal.	1.25 – 1.30	1.25 – 1.30	1.25 – 1.30
Glaubers salt, bags, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb.	.14 – .14½	.14 – .14½	.14 – .14½
Lead:			
White, basic carbonate, dry casks, lb.	.05½–.....	.06½–.....	.06½–.....
White, basic sulphate, sck., lb.	.06 –.....	.06 –.....	.06 –.....
Red, dry, sck., lb.	.05½–.....	.06½–.....	.06½–.....
Lead acetate, white crys., bbl., lb.	.10½– .11	.10½– .11	.10½– .11
Lead arsenate, powd., bbl., lb.	.09 – .10	.09 – .10	.07 – .09
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk., lb.	.05½–.....	.05½–.....	.05½–.....
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06½
Methanol, 95%, tanks, gal.	.33 –.....	.33 –.....	.33 –.....
97%, tanks, gal.	.34 –.....	.34 –.....	.34 –.....
Synthetic, tanks, gal.	.35½–.....	.35½–.....	.35½–.....
Nickel salt, double, bbl., lb.	13 – .13½	.12½– .13	.11½– .12
Orange mineral, csk., lb.	.09½–.....	.09½–.....	.09½–.....
Phosphorus, red, cases, lb.	.44 – .45	.44 – .45	.44 – .45
Yellow, cases, lb.	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb.	.07½– .08½	.07½– .08½	.07½– .08½
Carbonate, 80-85%, calc. csk., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Chlorate, powd., lb.	.08½– .09	.08½– .09	.09½– .10
Hydroxide(c'stic potash) dr., lb.	.06½– .06½	.06½– .06½	.06½– .06½
Muriate, 80% bgs., ton	22.00 –.....	22.00 –.....	22.00 –.....
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.18 – .19	.18 – .19	.18 – .19
Sal ammoniac, white, casks, lb.	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.05½– .06½	.05½– .06½	.05½– .06½
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., lb.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt.	1.275–.....	1.275–.....	1.24 –.....
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.023– .024	.023– .024	.022– .024
Prussiate, yel. drums, lb.	.11½– .12	.11½– .12	.11½– .12
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	18.00 –.....	18.00 –.....	18.00 –.....
Chloride, dr., lb.	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl, lb.	.07 – .07½	.07 – .07½	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.53 –.....	.55 –.....	.56 –.....
Crystals, bbl., lb.	.38 –.....	.39 –.....	.38 –.....
Zinc chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05½– .06
Carbonate, bbl., lb.	.09½– .11	.09½– .11	.09½– .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.38 – .42
Dust, bbl., lb.	.066– .07	.066– .07	.059– .07
Zinc oxide, lead free, bag, lb.	.05 –.....	.05½–.....	.06½–.....
5% lead sulphate, bags, lb.	.04½–.....	.05½–.....	.06½–.....
Sulphate, bbl., cwt.	2.65 – 3.00	2.75 – 3.00	2.75 – 3.00

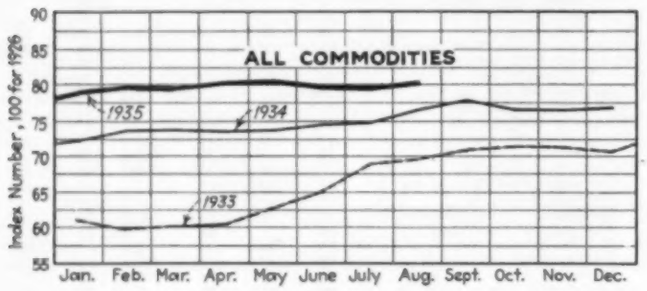
Oils and Fats

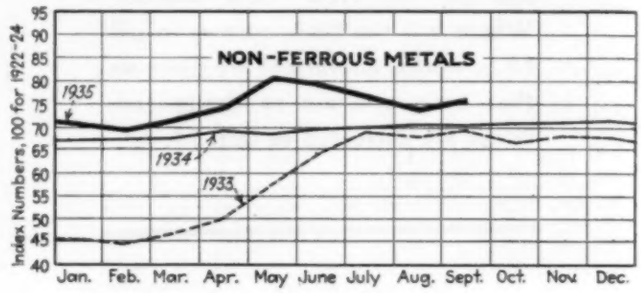
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½–$0.10	$0.09½–$0.10	$0.09½–$0.10
Chinawood oil, bbl., lb.	.35 –.....	.22 –.....	.095–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.05 –.....	.04 –.....	.03½–.....
Corn oil crude, tanks, (f.o.b mill), lb.	.09½–.....	.09½–.....	.07½–.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.09½–.....	.09 –.....	.07 –.....
Linseed oil, raw car lots, bbl., lb.	.09⅞–.....	.083–.....	.083–.....
Palm, casks, lb.	.05 –.....	.04½–.....	.03½–.....
Palm kernel, bbl., lb.	.05½–.....	.05½–.....	.03½–.....
Peanut oil, crude, tanks (mill), lb.	.09½–.....	.09½–.....	.07½–.....
Rapeseed oil, refined, bbl., gal.	.50 – .52	.45 – .46	.42 – .43
Soya bean, tank, lb.	.08½–.....	.08 –.....	.06½–.....
Sulphur (olive foots), bbl., lb.	.10 –.....	.08 –.....	.07½–.....
Cod, Newfoundland, bbl., gal.	.35 –.....	.35 –.....	.38 –.....
Menhaden, light pressed, bbl., lb	.068–.....	.065–.....	.056–.....
Crude, tanks(f.o.b.factory), gal.	.32 –.....	.28 –.....	.22 –.....
Grease, yellow, loose, lb.	.06½–.....	.05½–.....	.04½–.....
Oleo stearine, lb.	.11½–.....	.12 –.....	.10 –.....
Red oil, distilled, d.p. bbl., lb.	.09½–.....	.09½–.....	.07 –.....
Tallow, extra, loose, lb.	.07½–.....	.06½–.....	.05½–.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 –$0.65	$0.60 –$0.65	$0.60 –$0.62
Refined, bbl., lb.	.80 – .85	.80 – .85	.80 – .85
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.14½– .15	.14½– .15	.14½– .15
Aniline salts, bbl., lb.	.24 – .25	.24 – .25	.24 – .52
Benzaldehyde, U.S.P., dr., lb.	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl, lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.48 – .52	.48 – .52	.48 – .52
Benzyl chloride, tech., dr., lb.	.30 – .35	.30 – .35	.30 – .35
Benzol, 90%, tanks, works, gal.	.15 – .16	.15 – .16	.19 – .20
Beta-naphthol, tech., drums, lb.	.22 – .24	.22 – .24	.22 – .24
Cresol, U.S.P., dr., lb.	.11 – .11½	.11 – .11½	.11 – .11½
Cresylic acid, 97%, dr., wks., gal.	.45 – .46	.42 – .43	.50 – .51
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl., lb.	.16 – .17	.16 – .17	.16 – .17
Dip oil, 25%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb.	.65 – .70	.65 – .70	.65 – .70
Naphthalene, flake, bbl., lb.	.05½– .06½	.05½– .06½	.06 – .07
Nitrobensene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.51 – .55	.51 – .55	.51 – .55
Phenol, U.S.P., drums, lb.	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal.	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.65 – .70	.65 – .70	.65 – .70
Salicylic acid, tech., bbl., lb.	.40 – .42	.40 – .42	.40 – .42
Solvent naphtha, w.w., tanks, gal.	.26 –	.26 –	.26 –
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.30 –	.30 –	.30 –
Xylene, com., tanks, gal.	.30 –	.30 –	.26 –

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grid., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.12 – .13	.11 – .13	.11½– .13
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb.	.36½– .38	.36½– .38	.35½– .37
Ultramarine blue, bbl., lb.	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb.	.26 – .27	.26 – .27	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.80 – .85	.80 – .85	.80 – .85
Vermilion, English, bbl., lb.	1.52 – 1.55	1.52 – 1.55	1.58 – 1.60
Chrome yellow, C. P., bbl., lb.	.14 – .16	.15 – .15½	.15 – .15½
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.09 – .10	.09 – .10	.06 – .08
Manila, bags, lb.	.09 – .10	.09 – .10	.16 – .17
Damar, Batavia, cases, lb.	.15½– .16	.15½– .16	.16 – .16½
Kauri No. 1 cases, lb.	.20 – .25	.20 – .25	.45 – .48
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton.	50.00 –	50.00 –	40.00 –
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	5.90 –	5.30 –	5.75 –
Turpentine, gal.	.52½–	.44½–	.53½–
Shellac, orange, fine, bags, lb.	.28 –	.25 –	.35 –
Bleached, bonedry, bags, lb.	.24 –	.21 – .22	.32 – .33
T. N. bags, lb.	.16 –	.14 – .15	.26 – .27
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –	13.75 –	13.75 –

INDUSTRIAL NOTES

THE FULLER CO., Catasauqua, Pa., has acquired from F. L. Smidth & Co., exclusive rights to the "Fluxo" conveying system for the United States and possessions, Canada, and Mexico.

LINK-BELT CO., Chicago, has appointed T. Frank Webster resident manager of its Boston office to succeed Horace Goldstein who has been assigned to engineering sales work at the Philadelphia office.

FISHER SCIENTIFIC CO., Pittsburgh, has been appointed exclusive sales representatives for Zeiss metallographical equipment and accessories in the Pittsburgh and Cleveland districts.

FANSTEEL PRODUCTS CO., INC., North Chicago, has changed its name to Fansteel Metallurgical Corp. The new name indicates no change in corporate structure or in organization.

THE TITUSVILLE IRON WORKS CO., Titusville, Pa., a division of Struthers-Wells-Titusville Corporation, have secured the manufacturing and sales rights for the Master Line of subscribers, separators and mixer heads, except in the state of California.

GLOBE STEEL TUBES CO., Milwaukee, has appointed the Miller Steel Co., Inc., Newark, N. J. as warehouse distributors in that section.

THE KENNEDY VALVE MANUFACTURING CO., Elmira, N. Y., has appointed William Godbey as its representative in Kansas, Nebraska, Western Missouri, and Southwest Iowa.

AJAX FLEXIBLE COUPLING CO., has moved its Philadelphia office to the Otis Building. V. L. Sanderson is in charge.

COMBUSTION ENGINEERING CO., INC., New York, has appointed Don S. Walker district manager of the Philadelphia office.

GENERAL REFRACTORIES CO., Philadelphia, has named the Chas. A. Strelinger Co. as dealer agents in the Detroit territory.

READ MACHINERY CO., INC., York, Pa., has appointed J. R. Stewart as its representative in the lower peninsula of Michigan with headquarters at 17511 Pennington Drive, Detroit.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1935	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$936,000	$427,000
Middle Atlantic	$84,000	$175,000	3,075,000	2,215,000
South	308,000	252,000	8,613,000	5,671,000
Middle West	315,000	775,000	9,267,000	8,265,000
West of Mississippi	1,458,000	1,528,000	6,933,000	5,472,000
Far West	1,160,000	.....	3,028,000	6,183,000
Canada	550,000	140,000	13,023,000	1,743,000
Total	$3,875,000	$2,870,000	$44,875,000	$29,976,000

PROPOSED WORK
BIDS ASKED

Briquette Plant—Lehigh Briquetting Co., K. A. Loven, Mgr., 322 5th St., N., Fargo, N. D., plans improvements to its briquette manufacturing plant, including installation of additional machinery and equipment, at Dickinson, N. D. Estimated cost $300,000.

Chemistry Building—Board of Regents, University of Washington, Seattle, Wash., is having plans prepared by F. A. Naramore, Clyde Grainger and Donald Thomas, Archts., Arcade Bldg., Seattle, and Bobb & Gould, Supervising Archts., Hoge Bldg., Seattle, for the construction of a chemistry building on the University Campus. Estimated cost $1,160,000.

Distillery — Rochester Distilling Co., 8 Exchange Pl., Rochester, N. Y., has acquired a refinery here and plans to alter same into a distillery for its own use. S. Firestone, 59 South Ave., Rochester, Archt. and Engr. Estimated cost $28,000.

Distillery—Worth Distilling Co., c/o Phillip Segal, 501 South Spring St., Greensboro, N. C., plans to construct an addition to its distillery. Estimated cost including equipment $28,000.

Factory—Climax Molybdenum Corp., Climax, Colo., plans extensions and additions to its factory here. Estimated cost $300,000.

Factory—Porcelain Metals, Inc., 58 Sedgewick St., Brooklyn, N. Y., plans alterations to its factory at Dutch Kills, Borden and Review Aves., Long Island City, N. Y. Estimated cost including equipment $28,000.

Factory—Superior Ceramic Tile Corp., 314 West 13th St., Anderson, Ind., L. S. Jones, Pres., has acquired a 25 acre tract at Fairview Ave. and Big Four R.R., and plans to construct 1 story, 70x370 ft. factory for the production of tile, pottery and dishes. This will be first unit estimated to cost $50,000; ultimate cost of project $150,000.

Factory—Pittsburgh Plate Glass Co., Elwood, Ind., plans to construct a new kiln at its factory in North 9th St. This plant manufactures equipment used in the other plants of the company. Estimated cost $40,000.

Fertilizer Plant—Sowega Fertilizer & Melon Assn., Valdosta, Ga., will soon take bids for the construction of an addition to its plant. Estimated cost $45,000.

Gas Plant—City, Sioux Falls, S. D., is having plans prepared by Black & Veatch, Engrs., 405 East 13th St., Kansas City, Mo., for the construction of a gas plant. Estimated cost $858,-354. P.W.A. application filed.

Graphite Factory — Acheson Graphite Co., Buffalo Ave., Niagara Falls, N. Y., will soon take bids for extensive alterations to factory buildings Nos. 8 and 17.

Laboratory—State Board of Health, Raleigh, N. C., Dr. J. H. Hamilton, Director, plans to construct a Laboratory of Hygiene on West Jones St. W. H. Deitrick, Raleigh, Archt. Estimated cost $160,000. P.W.A. application filed.

Oil Refinery — Acme Refining Co., Alma, Mich., is receiving bids for the construction of an oil refinery. Estimated cost $50,000.

Oil Refinery — Kent Refining Co., Grand Rapids, Mich., plans to construct an addition to its oil refinery. Estimated cost $75,000.

Oil Refinery—Shoreline Refining Co., Shreveport, La., plans addition to its refinery, also plant for canning lubricating oil, at Oil City, La. Estmated cost $75,000.

Paper Mill — Canadian International Paper Co., Ltd., Temiskaming, Ont., Can., plans to alter its mill to extend the use of "cloat," a liquid which produces white pulp. Estimated cost $300,000.

Pulp Mill—Annapolis Basin Pulp & Paper Co., Ltd., Bridgewater, N. S., Can., plans to construct a pulp mill. Estimated cost $250,000.

Sulphate of Alumina—Pan American Trading Co., 25 South William St., New York, N. Y., is in the market for 3,000 tons of sulphate of alumina. Send samples of two or three pounds with quotation.

CONTRACTS AWARDED

Bentonite Plant—Filtrol Corp., South Jackson, Miss., will build a plant for processing Bentonite (volcanic ash). Separate contracts are now being awarded for the work. Estimated cost including equipment $28,000.

Distillery—Baltimore Pure Rye Distilling Co., Dundalk, Md., awarded contract for bottling plant at its distillery at Sollers Point Rd., to Engineering Contracting Co., North and London Sts., Baltimore, Md. Estimated cost $35,000.

Distillery—Lynchburg Distillery Co., Lynchburg, O., awarded contract for reconditioning its distillery to Eugene Corlin, Fayetteville, O. Estimated cost $75,000.

Factory—E. I. du Pont de Nemours Co., Inc., Niagara Falls, N. Y., awarded contract for addition to factory on Buffalo Ave., to Laur & Mack Contg. Co., Inc., 1400 College Ave., Niagara Falls.

Fertilizer Factory—Baugh & Sons, Berkley Point, Norfolk, Va., awarded contract for construction of fertilizer factory, to Consolidated Engineering Co., 20 East Franklin St., Baltimore, Md. Estimated cost $40,000.

Fertilizer Factory—Victor Fertilizer Co., Gaffney, S. C., plans improvements to its factory. Separate contracts have been awarded. Estimated cost including equipment $28,000.

Glass Factory—Demuth Glass Works, 11th St. and Wythe Ave., Brooklyn, N. Y., will alter their glass factory. Work will be done by separate contracts. G. J. Smith, 32 Miriam St., Valley Stream, L. I., Archt.

Glass Factory — Dominion Glass Co., 1111 Beaver Hall Hill, Montreal, Que., Can., awarded contract for extension to plant to W. H. Cooper, 42 James St. N., Hamilton, Ont. Estimated cost $100,000.

Laboratory—Abbott Laboratories, 14th St. and Sheridan Rd., North Chicago, Ill., will build an addition to its plant. Separate contracts have been awarded for the work. Estimated cost including equipment $100,000.

Laboratory—Canadian International Paper Co., Ltd., Main St., Hawkesbury, Ont., Can., awarded contract for the construction of a laboratory to A. F. Byers & Co., Ltd., 1226 University Ave., Montreal, Que. Equipment will be purchased later. Estimated cost $40,000.

Laboratory — Owens-Illinois Glass Co., 965 Wall St., Toledo, O., awarded contract for 2 story laboratory building to G. W. Lathrop & Sons, 1220 Madison Ave., Toledo. Estimated cost $100,000.

Leather Factory—Elkland Leather Co., Elkland, Pa., will build an addition to its hide and leather factory. Project includes installation of 150 new vats and other equipment. Work will be done by separate contracts and day labor.

Oil Refinery — Pan American Refining Co., Texas City, Tex. (subsidiary of Standard Oil Co. of Indiana), is now awarding separate contracts for proposed new plant to cost $1,500,000. Contract for catalytic polymerization unit awarded to Foster Wheeler Corp., 165 Bway., New York, N. Y. Esimated cost $100,000.

Soap Factory — General Soap Co., Madison Ave. and West 115th St., Cleveland, O., awarded contract for addition to factory to Samuel Miller, office on premises of owner. Estimated cost $50,000.

Starch Factory—Fort Loudon Products Co., Madisonville, Tenn., will construct a starch plant. Separate contracts have been awarded for the work.

Tannery—Bona Allen Mfg. Co., Buford, Ga., awarded contract for 3 story addition to its tannery, to Capital Construction Co., 62 Barton St., Atlanta.

Tannery—J. K. Mosser Leather Co., H. W. Boyd, Pres., Williamsport, Pa., awarded contract for alterations and improvements to its tannery, including installation of new boilers and other equipment, to Lundy Construction Co., Williamsport.

Grain Dryer — Archer-Daniels-Midland Co., Hamburg Turnpike, Buffalo, N. Y., awarded contract for grain dryer for linseed oil manufacture, to McKenzie-Hague Co., 422 Corn Exchange Bldg., Minneapolis, Minn.

Storage Building — Pittsburgh Plate Glass Co., 253 East Pittsburgh Ave., Milwaukee, Wis., awarded contract for storage building and garage at Barclay and Florida Sts., to Kroening Construction Co., 4500 West Mitchell St., Milwaukee.

Varnish Factory—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., awarded contract for addition to plant to be used as varnish factory on Chester Ave., Newark, N. J., to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa.

Warehouses—Hiram Walker & Sons, Peoria, Ill., awarded contract for rack warehouses to Lundoff-Bicknell Construction Co., 100 North La Salle St., Chicago, Ill. Estimated cost $450,000.

Warehouse—George T. Stagg Co., Frankfort, Ky., awarded contract for distillery warehouse to J. D. Jennings, 328 East Breckenridge St., Louisville. Estimated cost to exceed $100,000.

ZINC OXIDE PRODUCTION DECLINES BECAUSE COMPETING MATERIALS GAIN FAVOR

ONE OF the most important developments in the last month was the announcement of a sharp decline in prices for all grades of zinc oxide for delivery over the final quarter of the year. The largest reduction applied to the U.S.P. grade which was marked down from 12¾c. per lb. to 8c. per lb. The revised schedule for 20 ton carlots and less, packed in bags is: American process, lead-free, carlots 5c. per lb. and less carlots 5¼c.; 5 per cent leaded, carlots 4⅞c. and less carlots 5⅛c.; 35 per cent leaded, carlots 4⅞c. and less carlots 5⅛c. French process, lead free carlots, 5c. and less carlots, 5¼c.; green seal, carlots 6c. and less carlots 6¼c.; red seal, carlots 5½c. and less carlots 5¾c.; and, white seal, carlots 6½c. and less carlots 6¾c. per lb.

While this price decline was attributed to competitive conditions largely of domestic origin, a study of statistics for that industry reveals that there has been a marked drop in exports from 1930 to date. In fact from 1932 to date there has been an excess of imports over exports. For the first seven months of this year imports of zinc oxide amounted to 1449 tons while exports were but 654 tons. Canada is still the largest buyer of zinc oxide but the loss in that direction may be realized from the fact that in 1929 our shipments to Canada were 7,702 tons whereas exports to the same country in 1933 were only 286 tons.

It is evident, therefore, that zinc oxide production abroad has had something to do with cutting down production and sales of the American product. Imports of zinc oxide have formed too small a percentage of total domestic sales to have been a factor on prices. Yet there has been a gain in imports this year and the larger receipts from abroad added to the competitive conditions which prevailed.

The real factor in bringing about the present price decline was the competition from domestic offerings produced from secondary metal. This competition, which took the form of price cutting, made comparatively heavy inroads on accustomed sales to the rubber trade. Steadily increasing output of titanium pigments also tended to cut into the markets formerly controlled by zinc oxide. This is said to have been especially true of high grade paints and enamels where titanium pigments had found an excellent outlet.

As an offset to the loss in sales of zinc oxide last year, considerable improvement is reported to have been shown in distribution of zinc sulphide. Lithopone also sold in a larger way, the totals being 145,565 tons for 1934 and 140,831 for 1933, the increase last year being due to larger consumption on the part of the paint trade as consumption in other lines declined.

The figures for distribution of zinc oxide according to consuming industries do not include totals for leaded zinc oxide. Nearly all of leaded zinc oxide is consumed in paints and distribution of zinc oxide, all grades, in 1934 shows a total of 50,173 tons, or 46.6 per cent for rubber; 44,117 tons or 41 per cent for paint; 4,781 tons or 4.4 per cent for floor coverings and textiles; 2,963 tons or 2.7 per cent for ceramics; and 5,560 tons or 5.3 per cent for other industries.

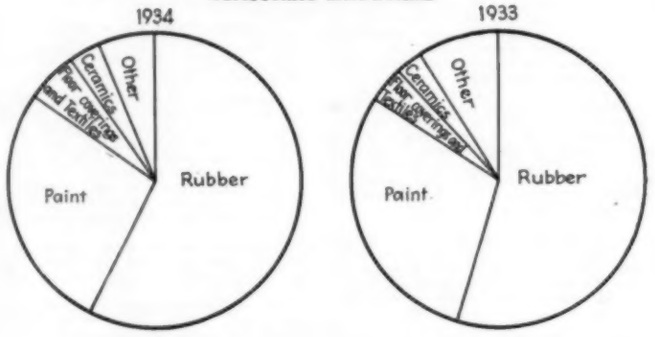
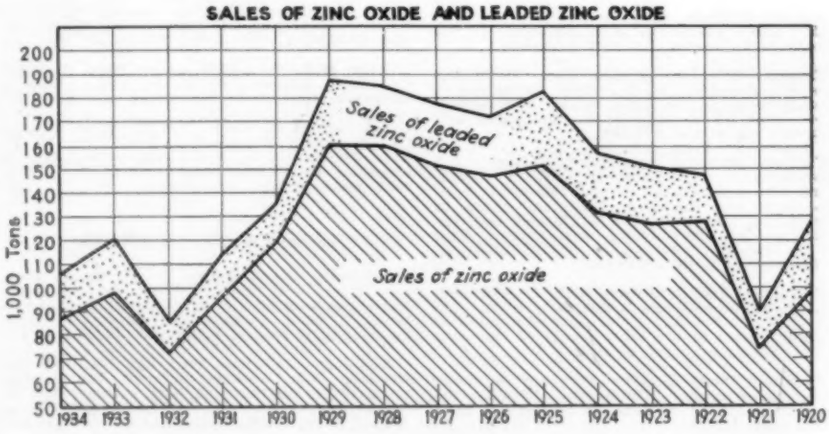
Distribution of Zinc Oxide According to Consuming Industries

Industry	1934 Tons	1933 Tons	Per Cent of Total 1934	Per Cent of Total 1933
Rubber	50,145	53,869	57.5	54.7
Paint	23,741	29,218	27.2	29.7
Floor coverings and textiles	4,781	4,087	5.5	4.0
Ceramics	2,963	2,639	3.5	2.7
Other	5,458	8,729	6.3	8.9
Totals	87,088	98,542	100.0	100.0

Domestic Sales and Foreign Trade in Zinc Oxide

	Sales					
	Zinc Oxide Tons	Leaded Zinc Oxide Tons	Total Tons	Imports Tons	Exports Tons	Apparent Domestic Consumption Tons
1934	87,088	20,506	107,594	1,267	1,155	107,706
1933	98,542	22,868	121,410	2,541	722	123,229
1932	72,250	14,305	86,555	2,672	1,261	87,966
1931	95,700	18,577	114,277	1,457	5,131	110,603
1930	119,142	17,279	136,421	1,135	10,753	126,803
1929	160,611	27,149	187,760	1,377	17,638	171,499
1928	160,904	24,223	185,127	1,455	14,799	171,783
1927	151,246	26,064	177,310	1,476	14,494	164,292
1926	146,923	23,859	170,782	1,221	14,661	157,342
1925	151,354	31,750	183,104	1,406	10,855	173,655
1924	131,470	26,729	158,199	1,813	3,927	156,085
1923	126,987	23,504	150,491	1,125	5,024	146,592
1922	128,465	19,613	148,078	2,754	3,977	146,855
1921	74,329	16,103	90,432	1,343	2,511	89,264
1920	99,444	30,460	129,904	1,445	11,164	120,185

DISTRIBUTION OF ZINC OXIDE ACCORDING TO CONSUMING INDUSTRIES



SALES OF ZINC OXIDE AND LEADED ZINC OXIDE